The American Journal of Surgery

EDITED BY THURSTON SCOTT WELTON, M.D.

February 1944

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NEW SERIES VOL. LXIII — *Contents • February, 1944* — NUMBER TWO

Editorial

Pilonidal Cyst . . . . . *Major J. William White* 151

Original Articles

Bone Grafts to the Mandible . . . . . *Gordon B. New and John B. Erich* 153

Cesarean Section. The Rational Use of This Operation . . . . . *Denver M. Vickers* 168

Carcinoma of the Gallbladder. A Clinical and Pathologic Study . . . . . *James L. Vadheim, Howard K. Gray and Malcom B. Dockerty* 173

Management of the External Biliary Fistula . . . . . *R. Russell Best* 181

Improved Technic for the Closure of a Loop Colostomy . . . . . *John William Howser* 187

Contents Continued on Page 3

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NEW SERIES VOL. LXIII *Contents • February, 1944* NUMBER TWO

Rapid Rehabilitation in the Shipbuilding Industry . . . . . *Kenneth A. Koerber* 192
Reconstruction of Nasal Tip. A New Technic . . . . . *Maxwell Maltz* 203
Pyogenic Liver Abscess in the Aged . . . . . *Captain Robert S. Smith* 206
Right Inguinal Hernia Following Lower Abdominal Incisions. A Report of Thirty-one Cases. . . . . *Major Norman W. Thiessen* 214
Rôle of Aseptic Bone Necrosis in Hip Lesions. . . . . *Ernst Bergmann* 218
Sedation in Patients with Acute Head Injury. . . . *E. S. Gurdjian and Major J. E. Webster* 236
Ceepryn. Clinical and Bacteriological Studies . . . . . *G. B. Kramer and S. H. Sedwitz* 240
Persistence of Pain after Appendectomy . . . . . *Bernard Judovich and James Dunn* 246
Cardiovascular and Respiratory Effects from Celiac Ganglia Stimulation in Man . . . . . *S. J. Martin, Laurence Miscall and E. A. Rovenstine* 249

Case Reports

Fracture of the Lesser Tuberosity of the Humerus . . . . . *S. L. Haas* 253
Ectopic Pregnancy. Gestation of Eight Months—Retained Eight Years . . . . . *Harry L. Denoon, Jr. and W. Carey Henderson* 257
Hernias. Report of Two Unusual Cases. *Captain Milton N. Camp and Major Sherman E. Andrews* 259
Permanent Urinary Continence Following Pelvic Surgery . . . *Commander Phineas Bernstein* 261
Right Traumatic Diaphragmatic Hernia . . . . . *John Roberts Phillips* 267
Postpartum Hematomas. Report of Four Cases . . . . . *Samuel Lubin and Irving Horowitz* 272
Subastragaloid Dislocation. Report of an Unusual Ski Injury . . . . . *Major Merle J. Brown and Captain Walter E. Brown, Jr.* 276

New Instruments

Modified Overhead Support for Postoperative Use . . *Walter G. Goehring and W. Orr Goehring* 278
Simple Apparatus for the Care of an Ileostomy . . . . . *John H. Grindlay* 280

Bookshelf Browsing

American Pioneers in Abdominal Surgery . . . . . *Bernard J. Ficarra* 282
Selected Book Reviews 297

General Information on Page 4 *Advertising Index on 3rd cover*

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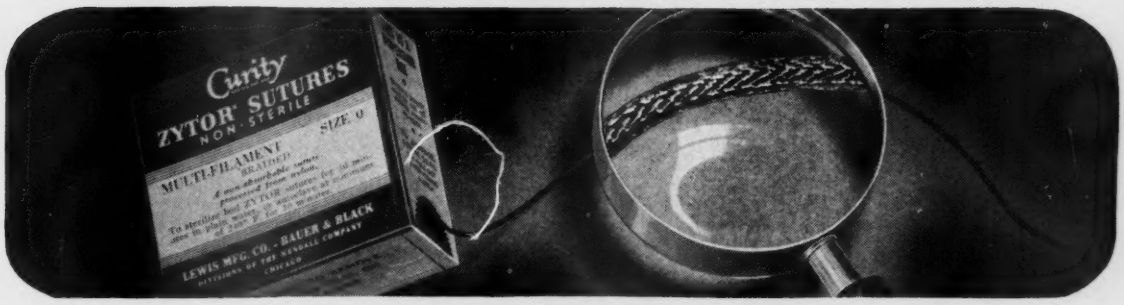

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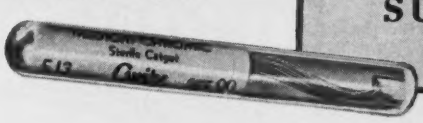

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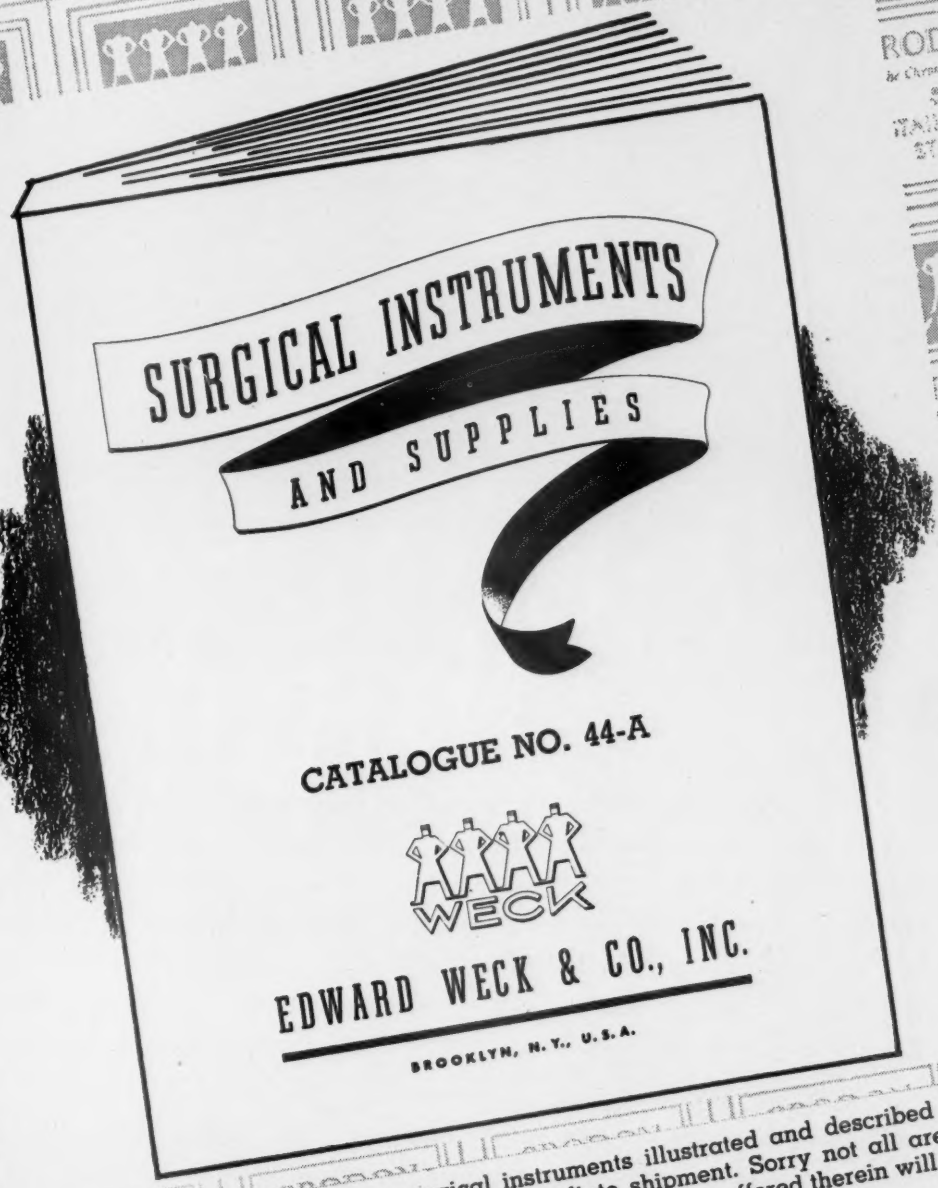

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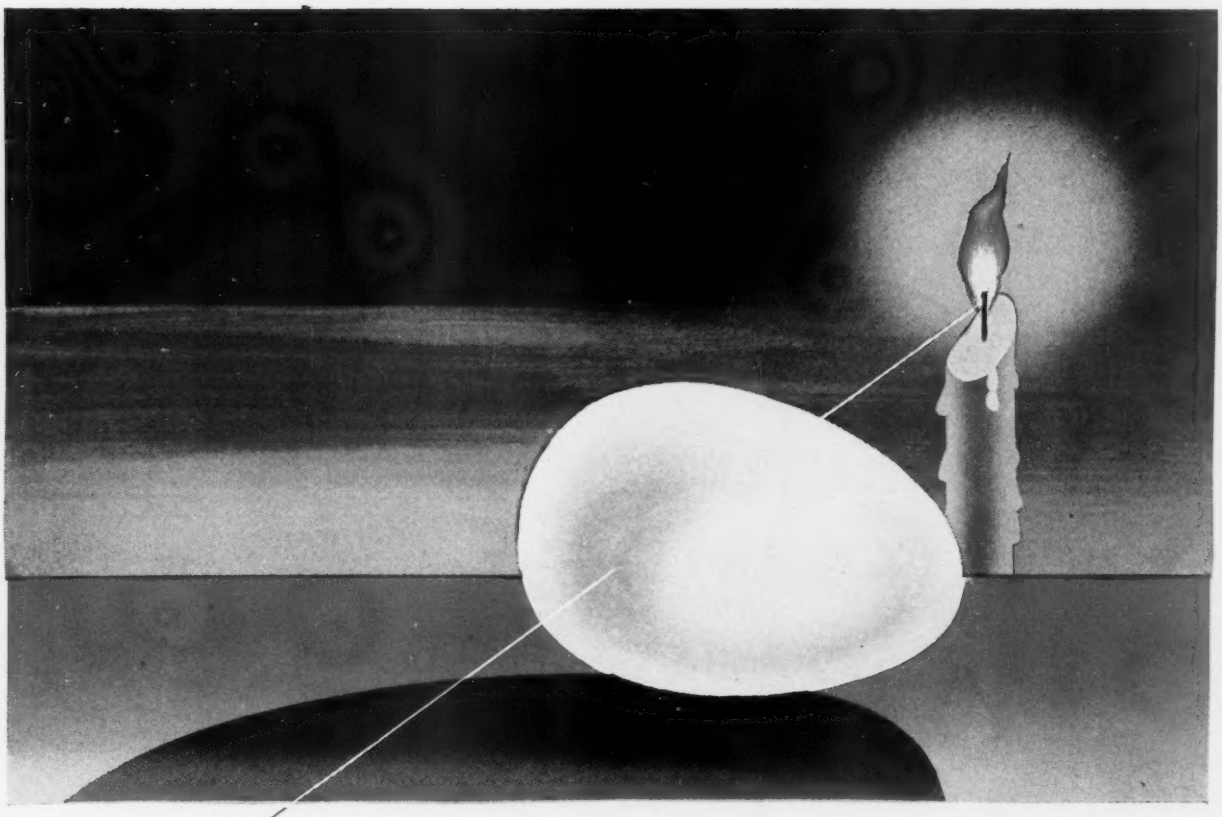

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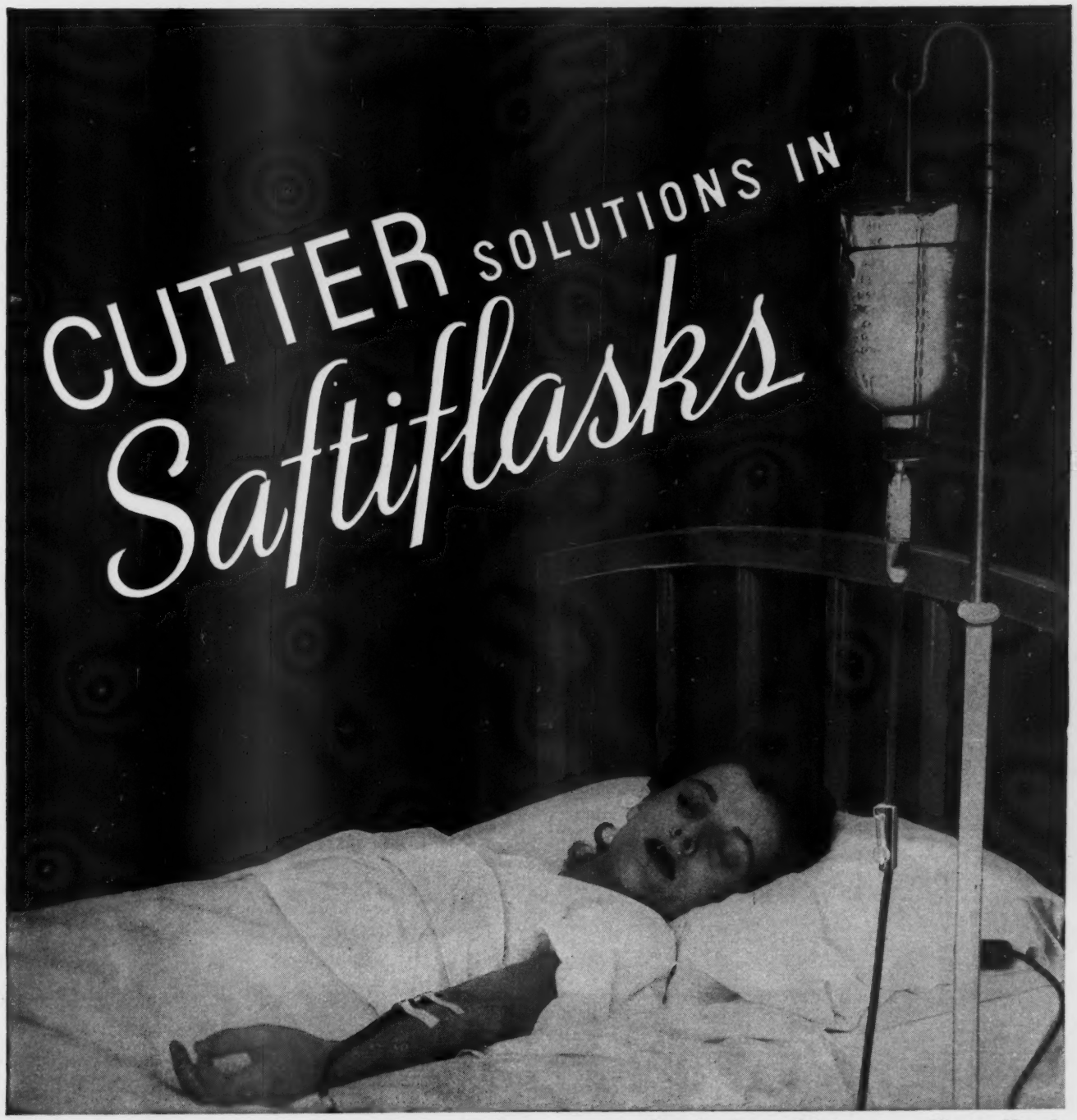

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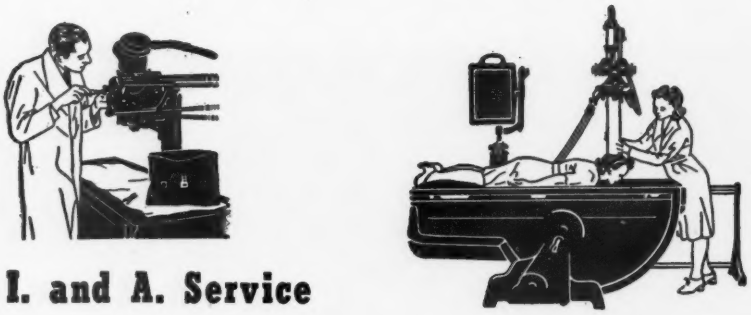

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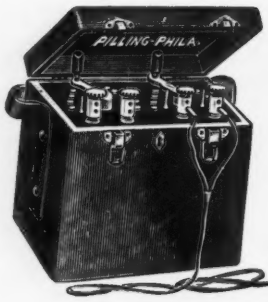

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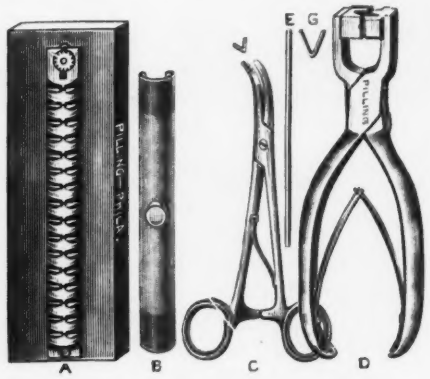

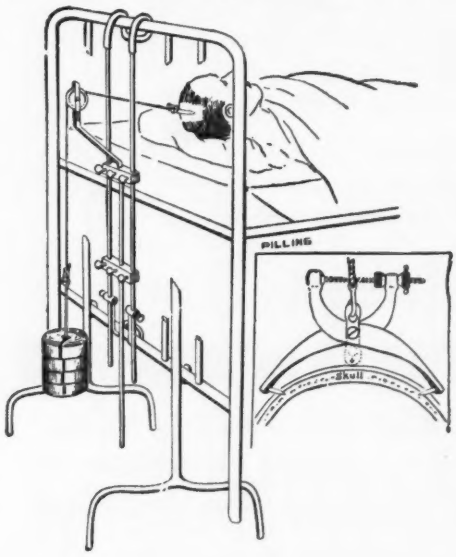

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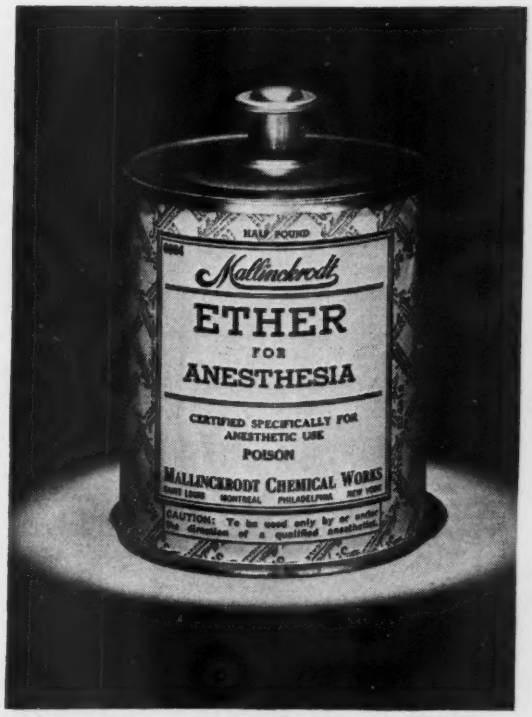

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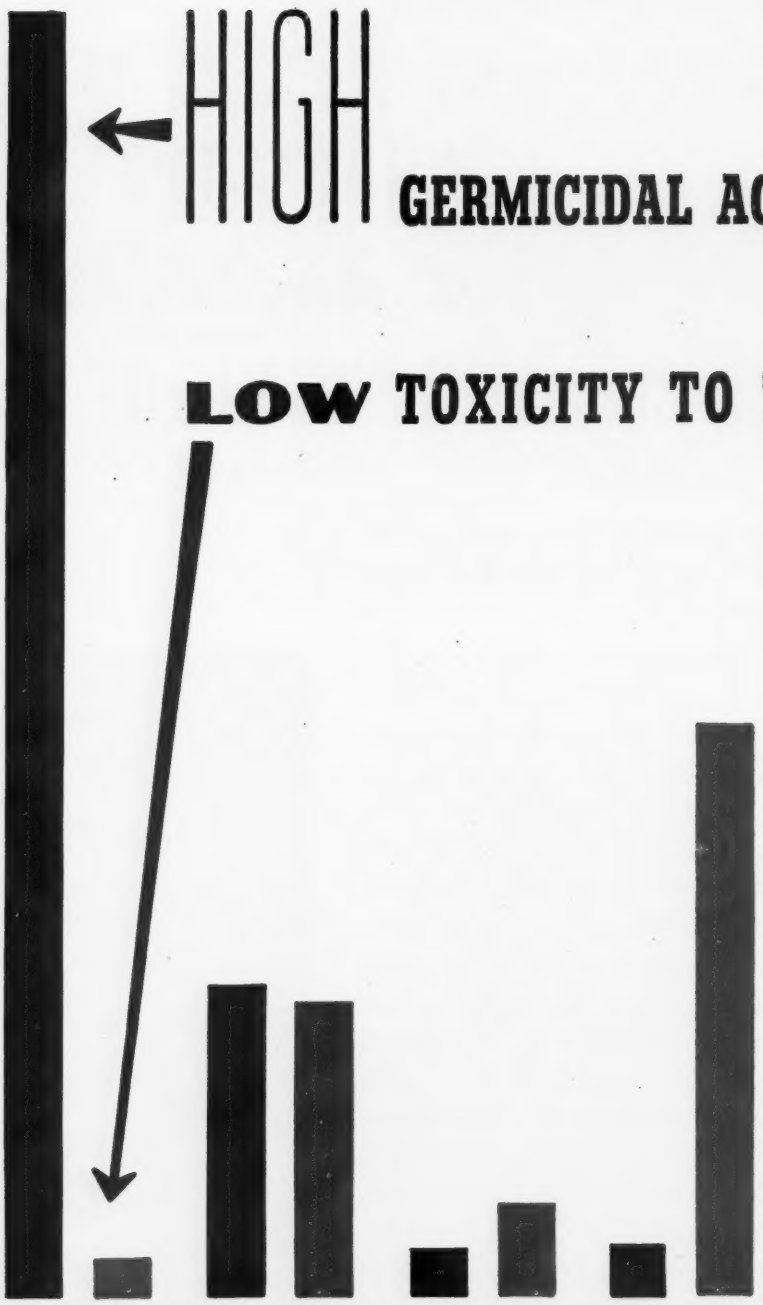

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REFERENCE: Green, T. W., and Birkeland, J. M.: A method of determining the toxicity of disinfectants, J. Bact. 43:641 (1942).

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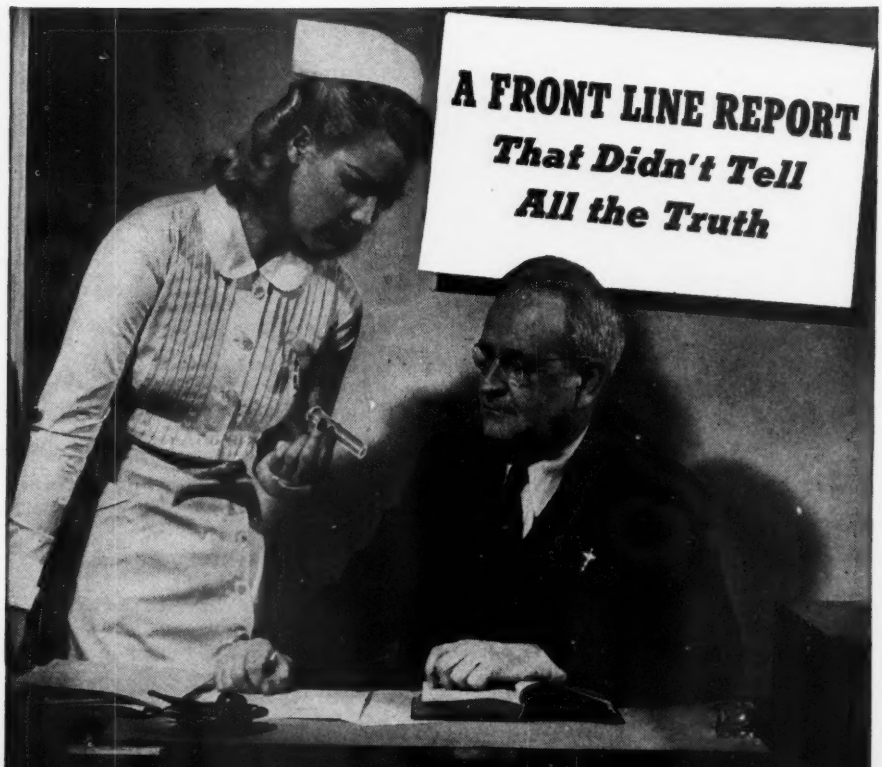

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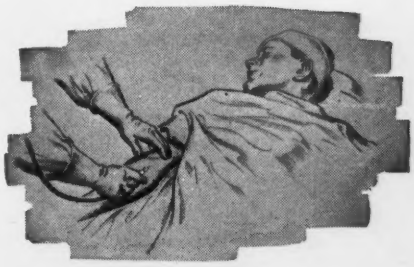

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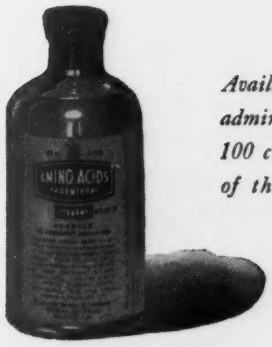

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Editorial

PILONIDAL CYST

IN recent months the subject of pilonidal cyst has been discussed frequently in American medical literature. Not uncommonly two or more articles dealing with similar or slightly differing phases of the condition have appeared in single issues of distinguished scientific journals. Space in several periodicals has been given for repeated reviews, serial case studies, statistical analyses, and the evaluation of technical procedures.

Obviously surgeons, authors, and editors realize the urgent need for improvement in the therapeutic approach to what has been for too long a tantalizing and harassing surgical enigma. Likewise, there is manifest a concerted eagerness to assist in resolving the problem; and a number of writers are making an effort to express the merits or defects of various technics, to encourage further investigation and to present a rational exposition of principles.

Circumstances are more propitious for vanquishing obscure complicating factors in the surgical eradication of pilonidal cyst than at any time in the history of the world. Surgery has attained an inestimable degree of perfection. Global conflict entails the concentration of millions of men in the armed forces. The vast majority of these fall into the age group (twenty to thirty) in which pilonidal cysts are most commonly encountered, and literally hundreds are being operated upon in army hospitals. The assignment of newly recruited troops to regions of warmer, if not equable, climate and the swift pace of training promotes glandular activity and the rapid accumulation of excretory products of the skin, macerated epithelium and dirt, which are significant elements in the activation of pilonidal cyst symptoms. Mechanization of warfare with its consequent vigorous jolting of combatants against scantily cushioned, metallic vehicular seats, accounts for a considerable percentage of symptom initiating incidents among members of mechanized units. The trauma induced during obstacle course maneuvers, particularly in the scaling of wall barricades, and that resulting from a stay of several successive days on bivouac, where protection and personal hygiene must be neglected, engenders adverse local reactions in new and is responsible at times for the dissolution of recently healed cases.

The treatment of contaminated but not grossly infected or abscessed pilonidal cysts consists of the removal or destruction of the cyst and its epithelial ramifications, but there is conflicting opinion as to how this can be most satisfactorily accomplished. For the most part surgeons practice radical excision and differ mainly in their method of closing the wound. Depending upon personal preference, but also

in large measure upon conditions encountered, block dissection (sharp or cautery) with open packing, partial closure, or complete primary suture of the wound are the procedures of choice. Radiation therapy and the use of sclerosing solutions, while effective in a small series of cases, are impracticable in most military hospitals. Plastic repair, like closed operations, results in a sufficient number of persistent or recurrent examples as to oppose its routine adoption.

The inapplicability of a solitary approach to all cases tacitly signifies the inadequacy of present standards. Whatever the recommended plan of therapy, it is subject to unequivocal deficiencies: prolonged or delayed healing, recrudescence of infection, infection with dissolution and recurrence.

Heretofore it was observed that, in unselected cases, wide excision and open packing offered the least chance of recurrence. However, the gratification of permanent benefit was vitiated by the delay in healing as well as by the inconvenience and time loss of the patient. Likewise, when cases were carefully selected, the reported results of partial or complete closure were largely unsatisfactory.

With the advent of war the time element in the development of an effective armed resistance assumed unprecedented proportions and attention was promptly focused upon the excessive number of man hours lost from training because of pilonidal cyst and its complications. Surgeons, quick in their response to the generously displayed verbal spur, "Minutes count," earnestly endeavored to improve the situation. Cases were reclassified and the technic moderately amplified, particularly through the local application of the sulfonamides and the use of non-absorbable suture material, but most noticeable was the definite trend toward primary, complete closure of the wound.

The majority of pilonidal cysts are contaminated and, therefore, are imbued with a potential of bacterial activity. In consequence, they should be surgically eradicated as early as possible and the wound promptly closed. More than half the cases examined show some degree of inflammation and not infrequently there is a history of abscess or drainage from a sinus.

Conservative treatment, indicated in acute inflammation or abscess, should be employed as a temporizing measure in preparation for radical surgery. If the inflammatory condition is subacute, or nearly resolved, and narrowly confined within the limits of the proposed elliptical incisions, radical operation may be performed at once; but if the inflammatory process is disseminated, or if pus is present, a minimum period of three weeks should elapse between the disappearance of inflammatory signs and bloc excision.

Recently an increasing number of patients, unselected except insofar as the presence of pus is concerned, are being treated by a revised closed method in which non-absorbable sutures are used and in which chemical bacterial inhibitors are omitted. The investigation thus far has shown that rather startling results are in the making.

Surgeons should continue in their endeavor to decrease the morbidity of pilonidal sinus. They should be encouraged by the realization that the future holds more in store for them than was known in the dilatory past. They should profit by the great, unpredictable opportunities that lie ahead.

Major J. William White, M.C.

Original Articles

BONE GRAFTS TO THE MANDIBLE*

GORDON B. NEW, M.D. AND JOHN B. ERICH, M.D.
ROCHESTER, MINNESOTA

BONE grafting is a subject which has come to occupy a relatively important place in discussions on traumatic injuries of the lower jaw. All bony defects interrupting the continuity of the mandible, whether the loss of bone is due directly to the injury or indirectly to necrosis following an infection, disturb to some degree the natural relation of the upper and lower dental arches, the normal masticatory mechanism and the symmetry of facial contour. Such maxillary changes call for readjustments and in the majority of instances there is little question but what a bone graft offers the most satisfactory method of repair. In the armed forces at the present time, mandibular injuries of this type are encountered fairly frequently and in all probability the number of such defects will increase noticeably in the near future. Consequently, it is reasonable to assume that bone grafting will become a comparatively common procedure in maxillofacial surgery.

There can be no doubt that much of the success of maxillary bone grafting depends on a most painstaking type of aseptic surgical technic and on the construction of dental and mechanical appliances which will maintain adequate immobilization of the bony fragments during the healing period. However, absolutely aseptic technic and perfect fixation do not always insure success. Other factors are sometimes present which ultimately lead to discouraging results. Unfortunately, these factors too frequently can neither be discovered before operation nor be coped with satisfactorily after operation.

CAUSES OF FAILURE OF BONE GRAFTS

A study of the causes which contribute to failures of bone grafting requires first an appreciation of the biologic and physiologic processes concerned in regeneration and repair of bone. Experiments conducted by many research workers seem to indicate that all or at least the greater portion of a bone graft undergoes gradual death. However, as the implant dies, new bone is formed to replace the dying bone. Shortly after transplantation, the graft becomes enveloped in a vascular form of fibrous tissue supplied by the bed in which the graft is placed. Excavations soon occur on the external surfaces of the implant and as the vascular tissue penetrates into the Haversian canals, a similar slow destructive process occurs in the Haversian system. Simultaneously with the foregoing activities, osteoblasts make their appearance on the surface and in the bony canals of the graft, and promptly begin to produce new bone. It is thought that physiochemical substances released by the disintegrating transplant stimulate the formation of new osseous tissue.

Much controversy exists as to the origin of the osteoblasts. Some authors believe that they are derived from the periosteum and endosteum of the graft as well as from the ends of the bony fragments. Others take exception to this hypothesis and believe that all osteoblasts transplanted with the graft die; it is their opinion that, while some of the osteogenic cells producing new bone in and about the graft are derived from the fragments, the greater number

* From the Section on Laryngology, Oral and Plastic Surgery, Mayo Clinic.

arise as the result of metaplasia of undifferentiated connective tissue cells enveloping the graft. Although, at the present time, there is no way of determining the origin of these bone-forming cells, the problem is not without clinical significance, as will be pointed out later.

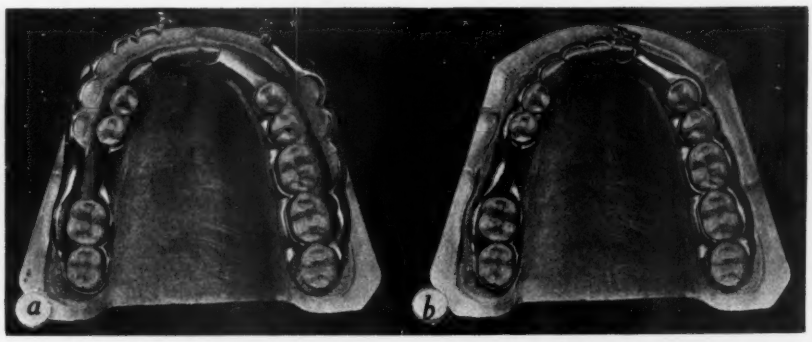

FIG. 1. Sectional hinged splint cast of silver for retaining the fragments of the lower jaw in correct alinement prior to a bone graft operation. This type of splint is used when several teeth are present in each fragment. *a*, splint open; *b*, splint closed and locked about the teeth by a wire passed around the divided button.

To sum up the physiologic processes which occur in the transplantation of bone, one might say simply that the graft is destroyed gradually and more or less completely and is replaced by newly formed bone which fuses with the ends of the bony fragments. The rapidity with which this phenomenon of destruction and substitution occurs depends to a large extent on the density of the transplant; the denser the bone, the more slowly will it be disintegrated and replaced.

In most instances, failures of bone grafting are the result of infection. The presence of pathogenic bacteria is likely to produce a rapid destruction not only of the cellular elements of the graft, but also of the osteogenic cells so essential to formation of new bone. In consequence, the implant becomes a sort of foreign body which ultimately is extruded. From a clinical standpoint, familiarity with the etiologic factors that favor the development of infections about bone grafts is most essential. It is always possible, of course, to carry pathogenic bacteria into the wound by improper sterilization of instruments or by faulty surgical technic. However, the most frequent cause of infection undoubtedly is a nick or a tear through the oral mucous membrane accidentally produced during the operative procedure. Even though such perforation may be extremely insignificant, it affords the means by which secretions from the mouth can enter and contaminate the wound.

Unfortunately, the source of some infections about bone grafts is not so obvious. Bacteria invading the wound at the time of the original injury may lie dormant in the tissues for many weeks without being destroyed and without causing any clinical evidence of infection. But on the introduction of a bone graft into the region, the subsequent inflammatory reaction stimulates these organisms to produce an acute infectious process. A latent infection then is a constant potential danger in bone grafting. It is imperative, therefore, that sufficient time elapse between the occurrence of the bony defect and the bone graft operation to free the tissues of all pathogenic organisms. Just how long the period between these two events should be is a matter of conjecture. It is our opinion that the insertion of a bone transplant to correct a mandibular bony defect of traumatic origin is best deferred for three or more months following the injury. If the loss of bone is due to necrosis or osteomyelitis, the patient then should be entirely free of symptoms (that is, swelling, discharge, pain or sequestra) for six to nine months

before the implantation of a bone graft is undertaken. While somewhat arbitrary, these time intervals in general are adequate.

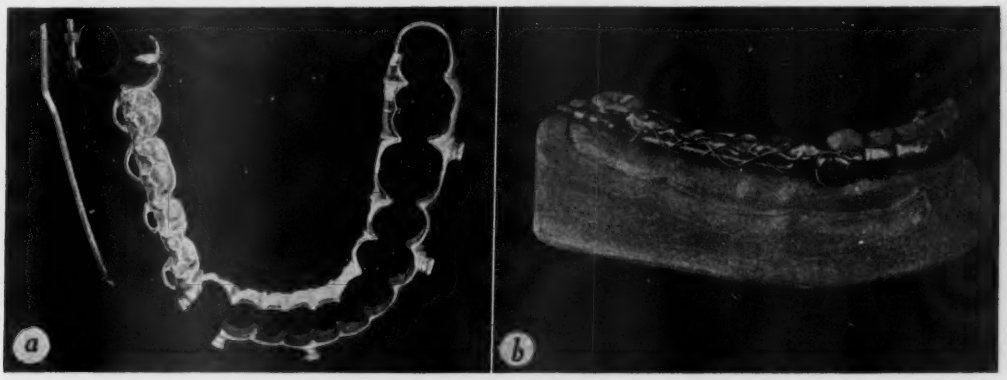

Fig. 2. Divided, hinged silver splint employed for immobilization when there is but one molar tooth in the posterior fragment. *a*, the splint spans the edentulous region of the lower jaw. An orthodontic molar band is placed around the single molar tooth in this fragment. A bar inserted in the sheath of this band and wired to the loops on the silver splint joins together the splint and molar band and, in turn, immobilizes the fragments; *b*, the bar wired in place, and the splint locked about the teeth by a wire passed around the divided button.

An infrequent but very definite cause for failure of bone grafting is the presence of extremely dense, avascular scar tissue intervening between and surrounding the ends of the bony fragments. Here, the blood supply is so poor that not only is adequate vascularization of the graft impossible but the production of osteogenic cells is markedly inhibited. Under these circumstances a bone graft is likely to undergo rapid death and sequestration.

Before dismissing this subject of etiologic factors which are responsible for failures of bone grafting, we should like to interject this thought: There can be no question but what in certain cases a bone graft does not "take" because there are lacking in the patient the necessary physiochemical and cellular reactions essential to the physiologic destruction and regeneration of the graft. Fortunately, this cause for failure of the transplantation of bone is rare.

MAINTENANCE OF THE FRAGMENTS OF THE MANDIBLE IN NORMAL POSITION DURING THE PREOPERATIVE PERIOD

During the interval of waiting between the time at which a portion of the mandible is lost and the time at which it is safe to proceed with the insertion of a bone graft, scar tissue forming between the fragments gradually pulls them together and disturbs their entire relation to the upper jaw. Moreover, the teeth themselves tend to shift, this displacement often becoming so marked that the former occlusion between the upper and lower teeth can never be restored. Shortly after the original injury it is desirable, therefore, to construct for each individual case an appliance which will maintain the fragments in their normal positions. What type of mechanism should be constructed depends entirely on the number of teeth present in each fragment.

When each fragment contains several teeth, a sectional hinged splint made of one of the acrylic compounds or silver (we prefer the latter) is ideal (Fig. 1). Such a splint consists of three sections hinged together posteriorly by half round wires. When it is placed about the teeth, the buccal segments are held together by a wire passed around a divided button. This appliance depends for retention, not on cement, but on its grip in the interdental spaces; and since it does not cover the occlusal surfaces of the teeth, there is no interference with occlusion. Finally, such a splint can be removed easily at frequent intervals for cleansing of the teeth and maintains the fragments in perfect position for any desired length of time.

In a mandible in which there is but one molar tooth in a short posterior fragment, it is inadvisable to use this type of splint

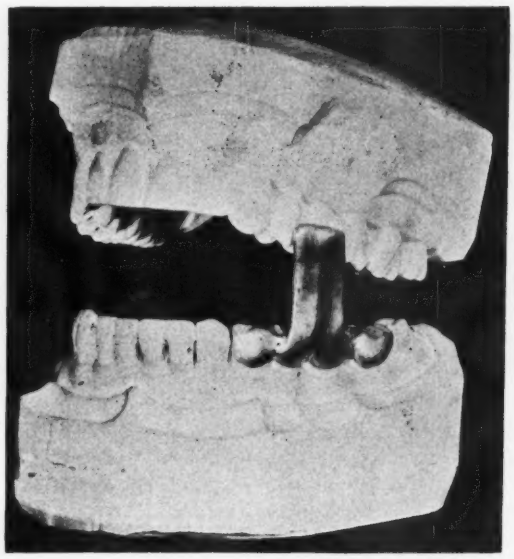

Fig. 3. A cast silver splint with a buccal flange to be used for immobilization when several teeth are present in the long anterior fragment but none in the posterior fragment. The flange rides on the buccal surface of the opposing upper teeth and thereby prevents mesial displacement of the long anterior fragment.

since it does not afford sufficient stabilization for the two fragments. Under these circumstances, we have devised a divided, hinged splint made of cast silver (Fig. 2); this is attached around the teeth of the long anterior fragment and spans the edentulous region in which there is a loss of bone. Attached to the molar tooth in the short posterior fragment is an orthodontic molar band which when screwed down cannot be displaced. The cast silver splint and molar band are then connected together by a rod which is wired securely to lateral loops on the former and which fits into the buccal sheath of the latter. Such a splint supplies the necessary fixation of the fragments.

Should there be several teeth in the anterior but none in the posterior fragment, it is advisable to construct a cast silver splint with a buccal flange (Fig. 3). This splint is cemented to the posterior teeth of the long fragment and, as the patient opens and closes his mouth, the flange rides on the buccal surface of the opposing upper teeth. If such an appliance is used, the long anterior fragment cannot be displaced mesially and can maintain its proper relation to the upper dental arch. Although the posterior fragment is likely to be rotated upward by muscular traction, it can be replaced later on. This same splint is to be recommended for retaining the mandible in position when one of the ascending rami is lost.

If both lower fragments are edentulous, there is no splint available for retaining the fragments in their normal positions. However, this problem is of no significance even though scar tissue does pull the fragments together, since the final contour of the lower alveolar ridge is of no great importance in an edentulous mandible.

If the fragments of a mandible in which there is a bony defect are not immobilized by some form of splint and are permitted to be drawn together by scar tissue, this scar must be incised to permit replacement of the fragments in their original relation to the upper jaw. This is particularly important in cases in which teeth are present in one or both fragments. Ordinarily, we incise the intervening scar tissue by means of a scalpel or scissors, cutting first through the oral mucous membrane and carrying the incision down across the dense scar below. When completely free, the two fragments can be manipulated easily into their former position and stabilized by one of the splints already described. Following such a procedure, the problem of infection of tissue again arises, necessitating deferment of a bone graft operation for at least three months.

Before one proceeds with the transplantation of bone to the mandible, it is most essential that every tooth whose roots are located near the ends of the fragments be extracted. Usually, we prefer that at least 2 cm. of bone beyond the free edge of each fragment be devoid of teeth. There is but one exception to this rule: If a tooth situated near the end of a fragment is the only means of fixation for that part of the

mandible, it should be retained. However, under these circumstances the bone graft must be attached to the fragment in a manner differing from the usual procedure. The removal of all teeth which will interfere with the application of a bone graft must be carried out at least three months prior to the insertion of the transplant. In fact, it is desirable to extract such teeth as soon as possible after the original injury, and preferably before a splint is constructed for the immobilization of the fragments. May we stress here the importance of obtaining good dental roentgenograms of all patients who are to have a bone graft applied to the mandible; by this diagnostic aid all teeth in the mandible which are infected or which will interfere with the proper application of the graft can be visualized clearly.

TECHNIC OF OPERATION

Two factors are essential to successful bone grafting: perfect asepsis and perfect immobilization. Since the mechanical devices for fixation of the fragments must be applied the day before the insertion of the transplant, this phase of the technic will be discussed first. Any appliance designed for fixation of the fragments must be more than a mechanism that merely holds the fragments; it must be an agent which maintains correct dental occlusion. Furthermore, it must be so constructed that it will give adequate immobilization during the time necessary for the graft to unite with the fragments, a period usually of six to eight weeks. Here again, the type of fixation to be used in each case depends entirely on the teeth which are present in the segments of the lower jaw and in the maxilla. Different types of fixation are shown in Figure 4.

In bone grafting to the mandible, we disapprove of the use of the many appliances which have been designed for external skeletal fixation. The most undesirable feature of these devices is that they are likely to interfere with the surgical exposure of the fragments and with the application of the graft. In addition, the bone pins or screws used with such appliances have a tendency to become loose before a strong bony union has developed between the graft and the fragments, thus permitting more or less displacement of the graft. Then, too, such appliances add a certain degree of risk to the operation, because of the remote but possible development of infection or necrosis in the tissues surrounding the pins or screws.

Fixation of Fragments of the Lower Jaw, Both Containing Several Teeth. Under these conditions, we employ a sectional hinged splint, such as has been shown in Figure 1. The buccal segments of this appliance are constructed with external buttons or with hooks for the attachment of intermaxillary wires. Applied to the upper dental arch is a half round or full round wire arch bar, which is made secure by wiring to each upper tooth. It is inadvisable to use on the upper teeth single loop or continuous loop wires, as these may tend to stretch and gradually permit some displacement of the segments of the lower jaw. Strong intermaxillary wires connected to the arch bar above and to the hooks on the silver casting below complete the steps necessary for thorough immobilization of the fragments.

Fixation of Fragments of the Lower Jaw in Which There Is but One Tooth in the Posterior Fragment. A cast silver splint is constructed for the mandible, such as has been shown in Figure 2. This appliance, when securely attached to an upper arch bar by means of intermaxillary wires, affords a means of perfect fixation for the fragments. (Fig. 4*a*.)

Fixation of Fragments in Which There Are No Teeth in the Posterior Fragment. In this situation, the long fragment containing teeth is made immovable by means of intermaxillary wires stretched between half or full round wire arch bars. The posterior fragment, on the other hand, is pulled backward and immobilized by a wire which is attached to a hook incorporated in a plaster head cast. (Figs. 4*b* and 5.)

In surgically exposing the angle of the mandible for insertion of a traction wire, blunt dissection should be employed so that no fibers of the facial nerve in the overlying soft tissues will be severed. Muscular attachments at the angle of the lower jaw are stripped away by periosteal elevators. Following exposure of the angle itself, a hole is made through the bone by means of an electrically driven drill. A double strand of wire (we prefer No. 26 gauge bronze or stainless steel wire) then is inserted through this hole and twisted in such a fashion that it can be attached later to the hook on the head cast. Finally, the soft tissues of the wound are sutured about the wire.

Care should be taken in this operative procedure to expose no more of the angle of the mandible than is absolutely necessary. It is also advisable to wait until the inflammatory reaction subsequent to the insertion of this traction wire has entirely disappeared before proceeding with the transplantation of the bone graft. Usually, this is a matter of about three weeks. It is to be remembered that this wire, when under tension, can pull completely through the bone in six to eight weeks. Therefore, in order that it shall provide immobilization of the fragment during the six to eight week healing period of the bone graft, it is important that this wire be left unattached to the plaster head cap hook until the day before the bone graft operation. This form of immobilization does not prevent slight mesial or lateral displacement of the edentulous fragment. However, this amount of motion does not interfere with healing of the bone graft.

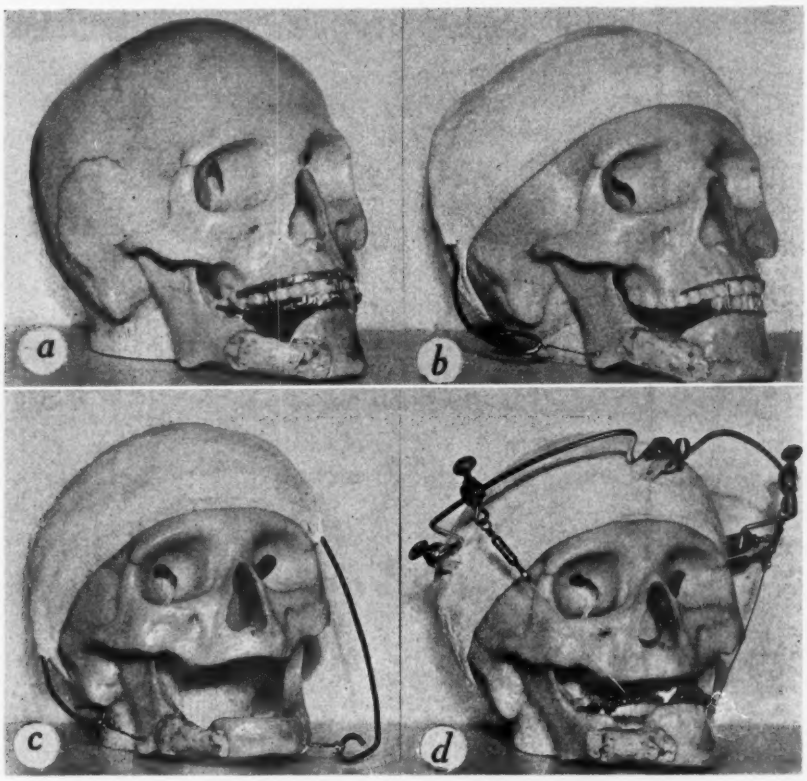

FIG. 4. Methods of fixation for the fragments of mandibles which have a bony defect requiring a bone graft. *a*, appliances used when there are teeth in both lower fragments; *b*, when there are no teeth in the posterior fragment; *c*, when the mouth is edentulous and *d*, when there are teeth in both lower fragments but none in the upper jaw.

Fixation of the Fragments When Both Fragments of the Lower Jaw Are Edentulous. Under these circumstances, there is no entirely satisfactory method of immobiliza-

tion for the fragments. However, as is shown in Figure 4*c*, wires attached to the two fragments and fixed to a plaster head wires which are attached to the splint on either side are passed through the soft tissues of the cheeks and are fixed to a

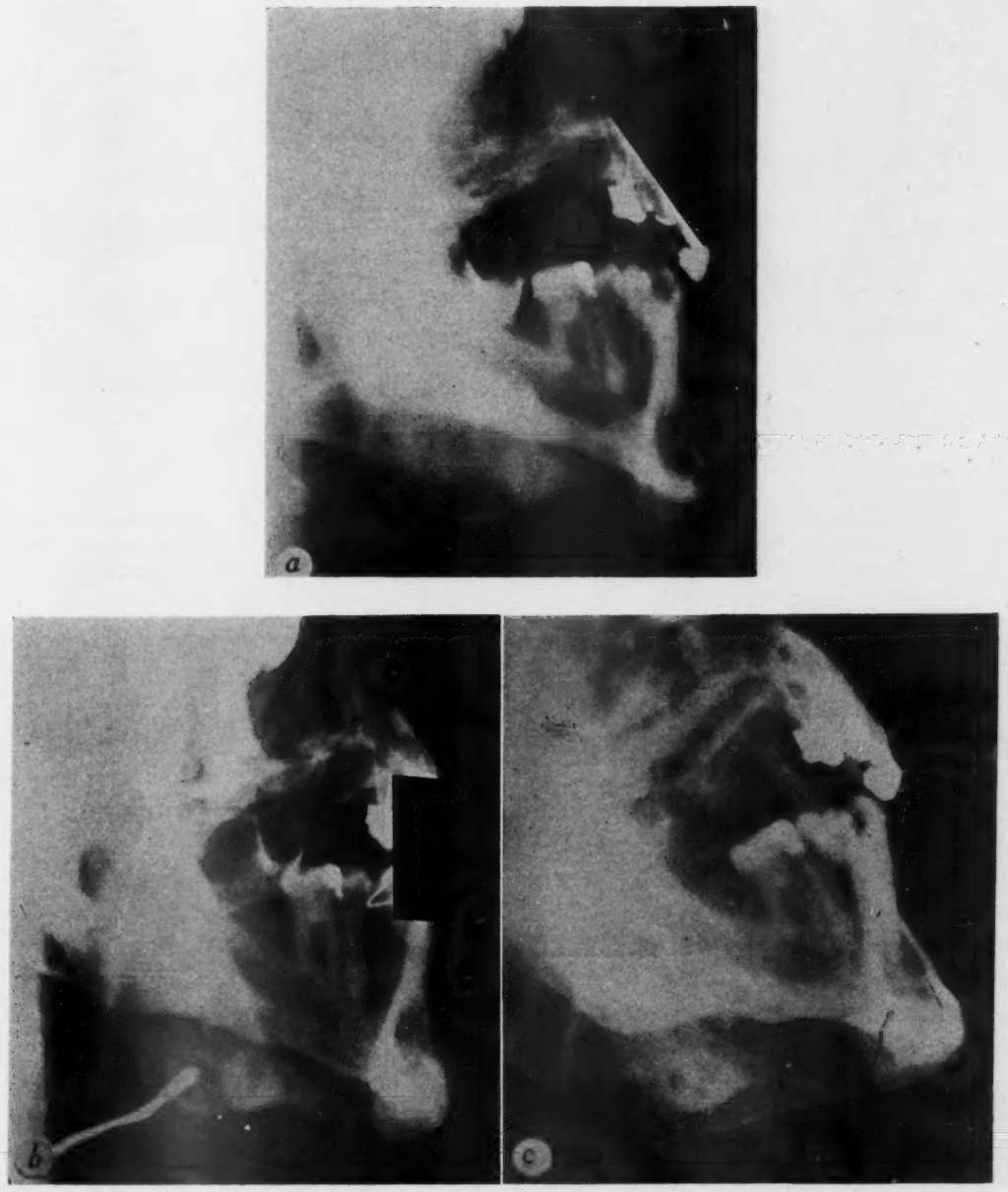

Fig. 5. Bony defect of mandible. *a*, before operation; *b*, posterior fragment pulled back into position by a wire inserted near the angle and fixed to a plaster head cast. The anterior fragment is immobilized by intramaxillary wires. *c*, postoperative view of the mandible with the bone graft in position. Fixation appliances have been removed.

cast, under ordinary circumstances, give sufficient fixation.

Fixation for the Fragments When There Are Teeth in Both Lower Fragments But None in the Upper Jaw. In this situation, a sectional hinged splint, such as is shown in Figure 4*d*, is used. In addition, traction plaster head cast above. We believe that such traction wires are a distinct advantage in providing added fixation in cases in which there are no upper teeth present to which intermaxillary wires can be attached.

Fixation of the Fragments When But One or Two Molar Teeth Are Left in Each Frag-

ment. Frequently when the loss of bone involves the anterior portion of the mandible, but one or two lower molar teeth are left on either side for fixation. Regardless of whether these teeth are loose, they should be retained for fixation of the fragments. However, when so few teeth remain, it is useless to employ a sectional splint. Instead, we attach an orthodontic band to a molar tooth in each fragment; then a round wire arch bar properly bent is inserted into the sheaths of these molar bands so as to maintain the desired distance between the fragments. (Fig. 6.) Complete immobilization is obtained by intermaxillary wires stretched between the upper teeth and the sheaths of the molar bands below.

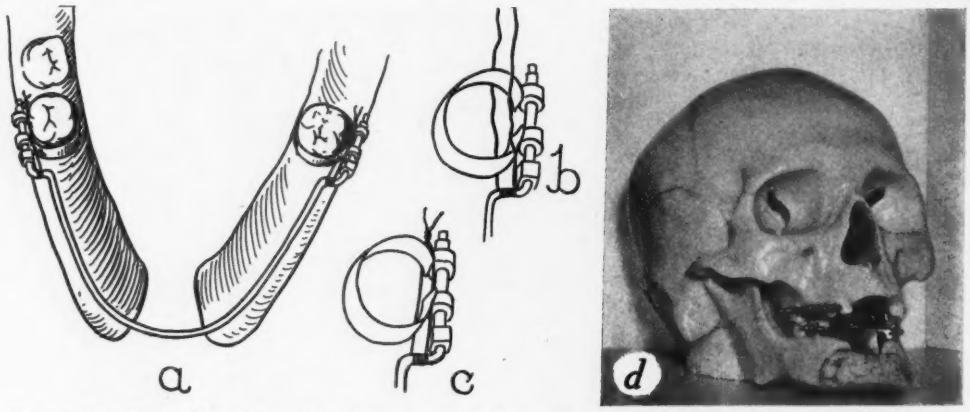

FIG. 6. Method of fixation of the fragments of a lower jaw in which there is an anterior defect and in which there is present only one molar tooth in each fragment. *a*, an orthodontic band is attached to a molar tooth in each fragment and a round wire arch bar, properly bent, is inserted into the buccal sheaths of the bands. *b* and *c*, a wire twisted around the arch bar on either side and then twisted about the side of the sheath of each molar band prevents the arch bar from being displaced. This bar maintains the desired distance between the fragments. *d*, intramaxillary wires from the lower molar bands to the upper teeth immobilize the lower fragments.

Choice of Bone for Graft. The anatomic regions from which sections of bone can be obtained for implantation over the mandible are numerous. The tibia, crest of the ilium, ribs and clavicle have been used for this purpose. In addition, sliding inlay grafts from the jaw bone adjacent to the defect have been employed. Just which one of these sites offers the best type of bone for transplantation is a debatable question. In view of the experimental work which has been done by many workers in recent years, there should be some scientific basis for making a selection of the region possessing bone most suitable for grafting. Since a bone graft undergoes a process of gradual disintegration and of regeneration, it would seem that the logical type of graft to use would be one which is composed of bone that is somewhat spongy or porous. Not only has it been demonstrated that a graft made up of extremely compact bone is vascularized slowly but its union to the jaw fragments also is much delayed when compared with the time required for the completion of these physiologic processes when the graft is porous and cancellous. There has been much discussion in the literature as to whether or not a graft should possess much cancellous bone. Although some experimental work would indicate that an excess of bone marrow has a detrimental effect on the tissue reactions about a bone graft, it is our opinion that a rather porous type of graft possessing some cancellous bone will give better results generally than will one composed of very compact bone.

Taking the foregoing factors into consideration, we believe that bone obtained from the crest of the ilium or from a rib is preferable to that obtained from other sites. Their histologic structure is very similar; both contain much cancellous

bone with a moderately thin layer of cortical bone. On the other hand, sliding inlay grafts from the mandible and implants from the tibia are composed of bone which is too compact to warrant their use. Bone from the clavicle we also do not employ, because anatomically it is a poor source of bone for transplantation.

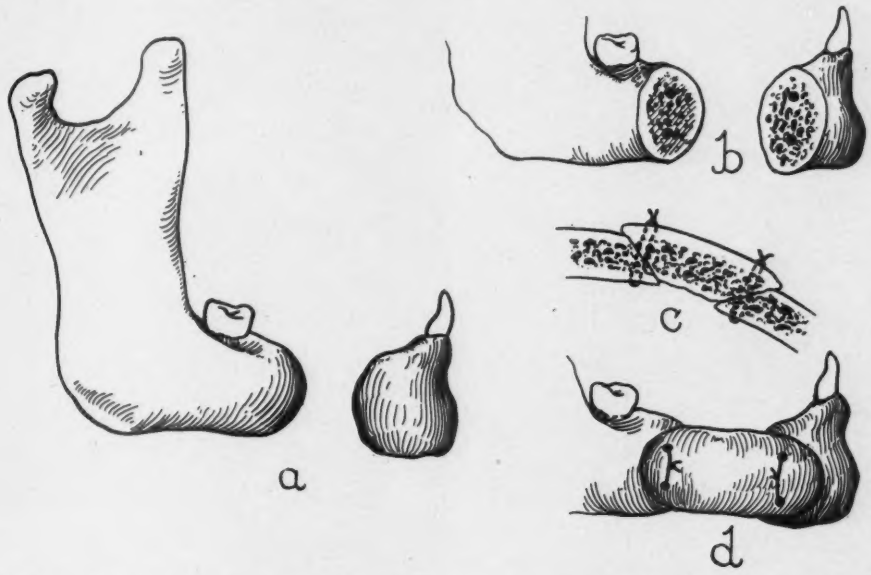

Fig. 7. Surgical preparation of the bony fragments for reception of a bone graft. *a*, the relation of the fragments to the defect is demonstrated; *b*, the end of each fragment has been ground down and beveled outward, exposing the cancellous bone. Two holes have been drilled in each fragment. *c*, bone graft (as seen from below and in cross section) has been cut to fit between the two fragments. Two heavy catgut ligatures inserted through the holes maintain the bone graft in proper position. *d*, bone graft tied in position (as seen from the buccal surface).

If one wishes to employ costal bone, we recommend cutting out a section of rib of the necessary length and splitting it longitudinally into halves; one or the other half is then selected for grafting. Since it is technically more difficult to secure bone from a rib than from the ilium and since it causes the patient more postoperative discomfort, we have chosen the crest of the ilium as the best site from which to obtain bone for grafting the mandible.

In removing bone from the ilium, a slightly curved skin incision passing down below the crest is used. After the subcutaneous tissues have been incised, periosteal elevators effectively remove the muscular attachments to this bone. When the crest is completely exposed, very thin, double-beveled chisels are employed to obtain a piece of bone of the required size. On removal of the graft from its bed, it is well to insert a drain which provides an outlet for the escape of any serum which may collect in the depths of the sutured wound.

There has been considerable difference of opinion as to whether or not a graft should possess its periosteal covering. Experimental work along this line would indicate that the cellular elements of the periosteum die shortly after the graft has been placed in position, but the presence of the periosteum aids in an early attachment of the surrounding connective tissue to the implant. Apparently, whether or not a graft is covered with its periosteum makes little difference in the ultimate healing of a bone graft but we think it preferable not to remove the periosteum.

Preparation of Site. Before one proceeds with the implantation of a bone graft into the mandible, all of the appliances necessary for fixation of the fragments must be in proper position. This

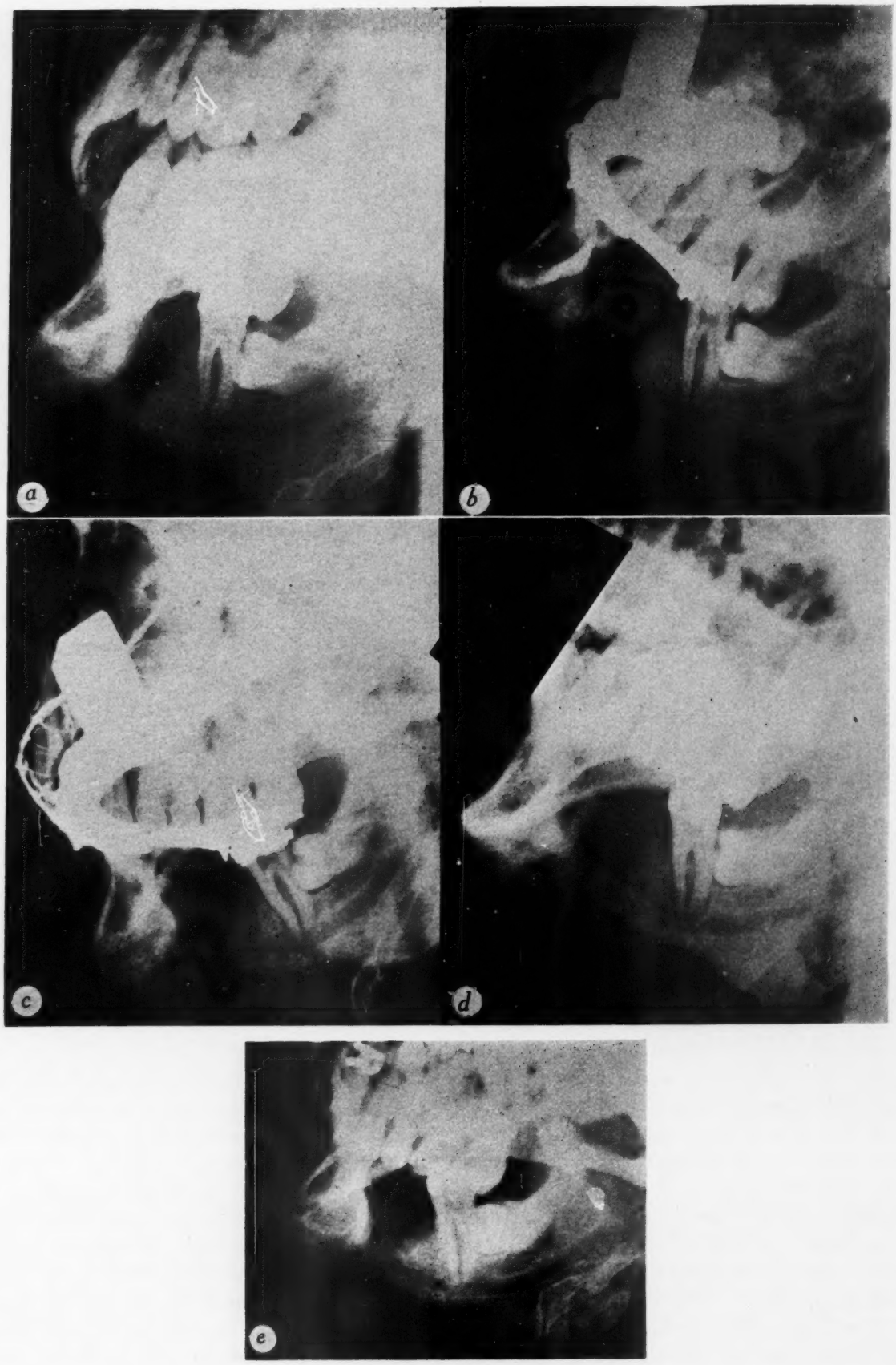

FIG. 8. For descriptive legend see opposite page.

type of operation progresses with the least amount of difficulty if performed with the patient under intratracheal gas and other anesthesia. Just below the mandibular defect, a cutaneous incision of sufficient length to give adequate exposure of the ends of the fragments is made. It is advantageous to make this incision at least 2 cm. below the lower border of the mandible, so that injury to the small branches of the facial nerve which supply a portion of the lower lip may be avoided. By blunt dissection, the ends of the fragments are exposed and with periosteal elevators the soft tissues surrounding the ends of the fragments are pushed aside. The most vulnerable point for a nick or tear through the oral mucous membrane is along the upper edge (alveolar ridge) of each fragment. However, adequate exposure of the ends of the fragments can be obtained without freeing the soft tissues over the alveolar border. Consequently, we believe that the tissues here should be left entirely alone, thus avoiding a possible perforation through the oral mucous membrane.

Following exposure of the outer (buccal) and inner (lingual) surfaces, as well as the lower border of each fragment, the free end is ground down and beveled outward for a distance of about 2 cm. (Fig. 7.) The grinding is continued until bleeding occurs from the cancellous portion of the bone. In this preparation of the end of the bony fragment, it is desirable to grind away the bone with a motor driven burr rather than to remove it with chisels, because the force exerted by a mallet or a chisel is sufficient to displace the dental appliance needed for subsequent fixation of the fragments. The foregoing technic completes the preparation of the fragments for reception of the bone graft.

Insertion of Graft. By means of rongeurs and bone chisels, the transplant itself is cut to the desired shape and its ends are beveled to approximate the ends of the bony fragments. Two holes are drilled through the ends of the fragments as well as through each end of the bone graft and by use of heavy dermal catgut the graft is tied to the fragments. (Fig. 7.) It is our opinion that wire, kangaroo tendon or other nonabsorbable material should not be used for attachment of the bone graft. Instead, one should rely on the mechanical devices already described for fixation. The ligature need hold the graft for only ten days to two weeks, at the end of which time sufficient fibrinous exudate and loose fibrous tissue will have formed to maintain the implant in the desired position. Consequently, we believe that it is better to use some material, such as catgut, which is absorbable. Following implantation of the graft, the soft tissues are sutured tightly without drainage. In the average case, immobilization is maintained for six to eight weeks.

Through a personal communication, we have been informed that many surgeons in England are employing cancellous bone chips from the crest of the ilium to correct bony defects of the mandible. These chips are merely packed into the wound between the fragments, no attempt being made to fix them in position. In our experience, such bone chips give satisfactory results if the width of the bony defect does not exceed a few millimeters. However, when there is a considerable loss of bone we believe that a good functional result can be obtained only by using a single piece of bone to bridge across the defect. In general, we prefer a rather large graft, even though its margins may protrude beyond the normal contour of the mandible. Any excess or protuberance of a

FIG. 8. Bone defect of mandible. *a*, preoperative view; *b*, appliances for immobilization are in position. The posterior fragment is held backward in its correct position; *c*, bone graft in position. Because of the fact that the tooth in the posterior fragment is close to the end of the fragment, the bone graft has been placed along the lower border of this fragment, so as to gain a greater contact surface between the fragment and the graft. *d*, bone graft healed; fixation appliances have been removed; *e*, two years after operation, the projection of bone along the lower border has become rounded off and the new bone has been built up between the two fragments, strengthening the entire mandible.

bone transplant will undergo a gradual process of resorption, so that ultimately the normal configuration of the mandible in the region of the defect will be established.

When, for reasons of immobilization, it is necessary to retain a tooth whose roots are located close to the end of a fragment, we prefer to attach the bone graft to the fragment below that portion of the bone which surrounds the roots. (Fig. 8.) If this is done, the graft has a broader surface of attachment but also may protrude conspicuously below the lower border of the mandible. This projection of the graft we do not attempt to remove. As is shown in Figure 8, all of this excess bone is absorbed gradually and the ultimate contour of the mandible is essentially normal.

The most common causes for failure of a bone graft to unite to a fragment are

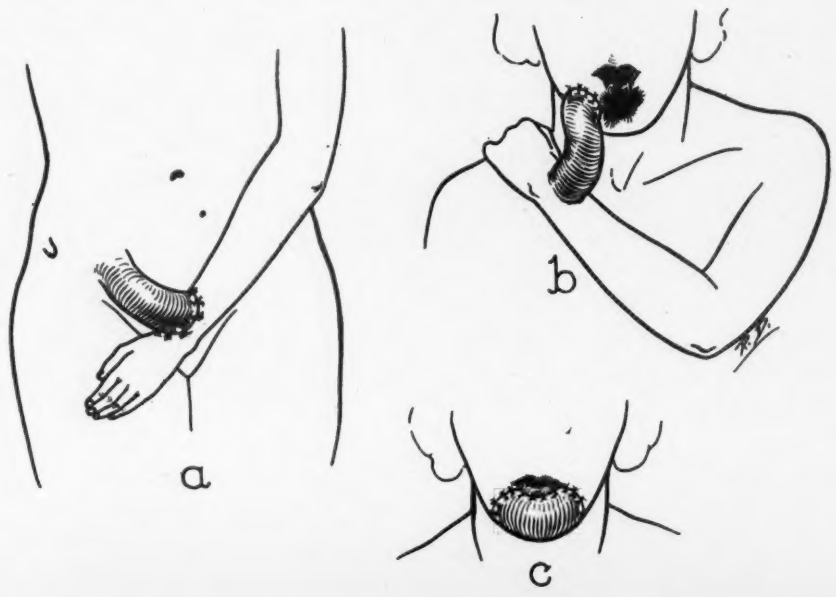

Fig. 9. Loss of the soft tissues of the chin occurring in conjunction with a loss of bone in the anterior part of the mandible. In cases such as this, the soft tissues must be reconstructed several months before a bone graft can be applied. *a*, *b*, and *c*, reconstruction of the soft tissues of the chin by means of an abdominal-wrist tube flap; *d*, preoperative view of the patient; *e*, postoperative view; the soft tissues of the chin have been reconstructed and a bone graft has been inserted.

(1) poor apposition of the graft to the fragment, (2) insufficient surface contact between the ground-down end of the fragment and the end of the graft and (3) sclerosis of the end of the fragment. While it is not essential that the graft and the end of the fragment fit flush, still there should be as wide a contact surface as possible. This is accomplished by grinding the surfaces until they rest firmly together. Should the end of a fragment be sclerosed or eburnated, it should be ground away until healthy cancellous bone is reached, as exhibited by proper hemorrhage.

Occasionally, particularly in war wounds, a defect of the mandible is associated with a loss of the overlying soft tissues. In such instances, it is necessary to reconstruct the soft tissues using some form of tubed skin graft containing much fat before one can proceed with a bone graft. (Fig. 9.)

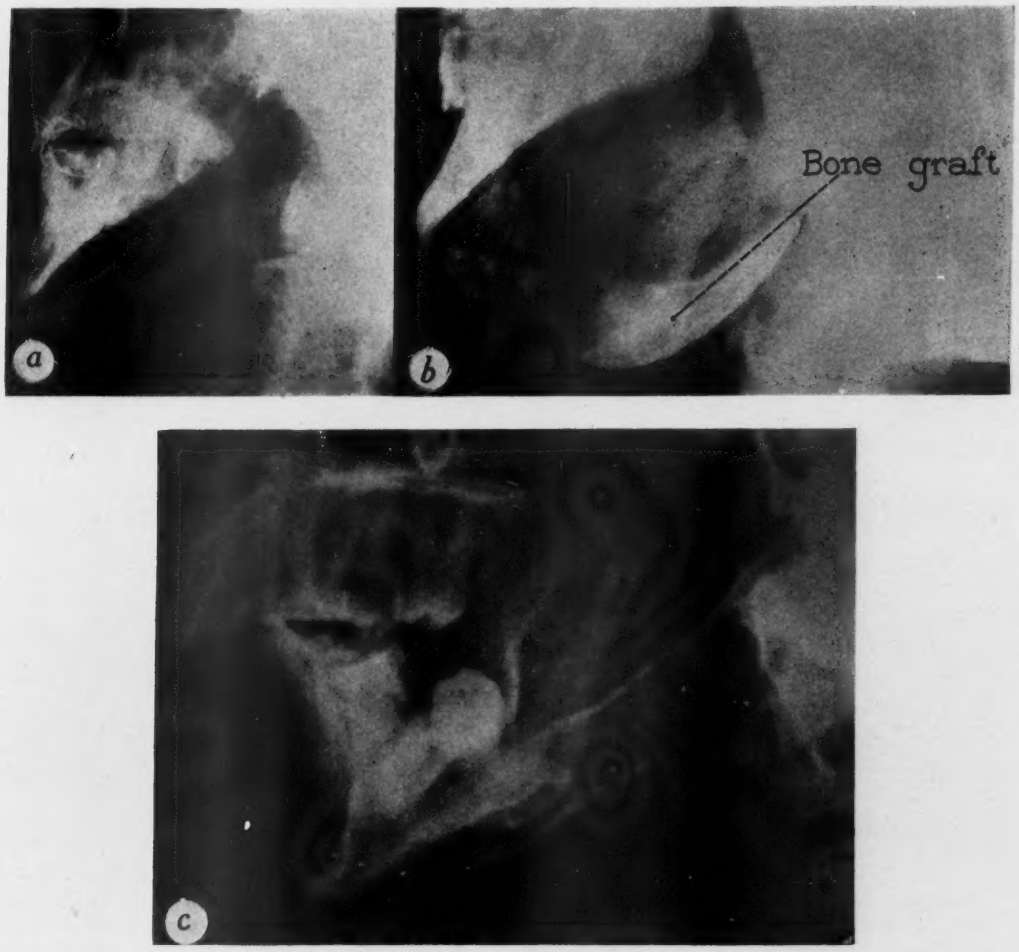

Fig. 10.—Loss of one ascending ramus of the mandible repaired by a bone graft obtained from a rib. *a*, before operation; *b*, after operation; *c*, sixteen years after operation.

RECONSTRUCTION OF ASCENDING RAMUS

The loss of one ascending ramus of the mandible is a fairly common war injury. Such a defect seriously interferes with mastication since the remaining portion of the mandible is drawn to the affected side. In constructing the lost part by means of a bone graft, it is to be remembered that the graft itself is never concerned with the subsequent functions of the mandible; it merely retains the lower jaw in its proper relation to the upper dental arch. It is our opinion that if the loss of bone extends forward beyond the region of the premolar teeth on the affected side, the defect is too extensive to warrant the

use of a bone graft. This is true because the graft would be too bulky and heavy for the remaining portion of the mandible conforms to the contour of a normal ascending ramus. One must, of course, use the iliac bone corresponding to the side

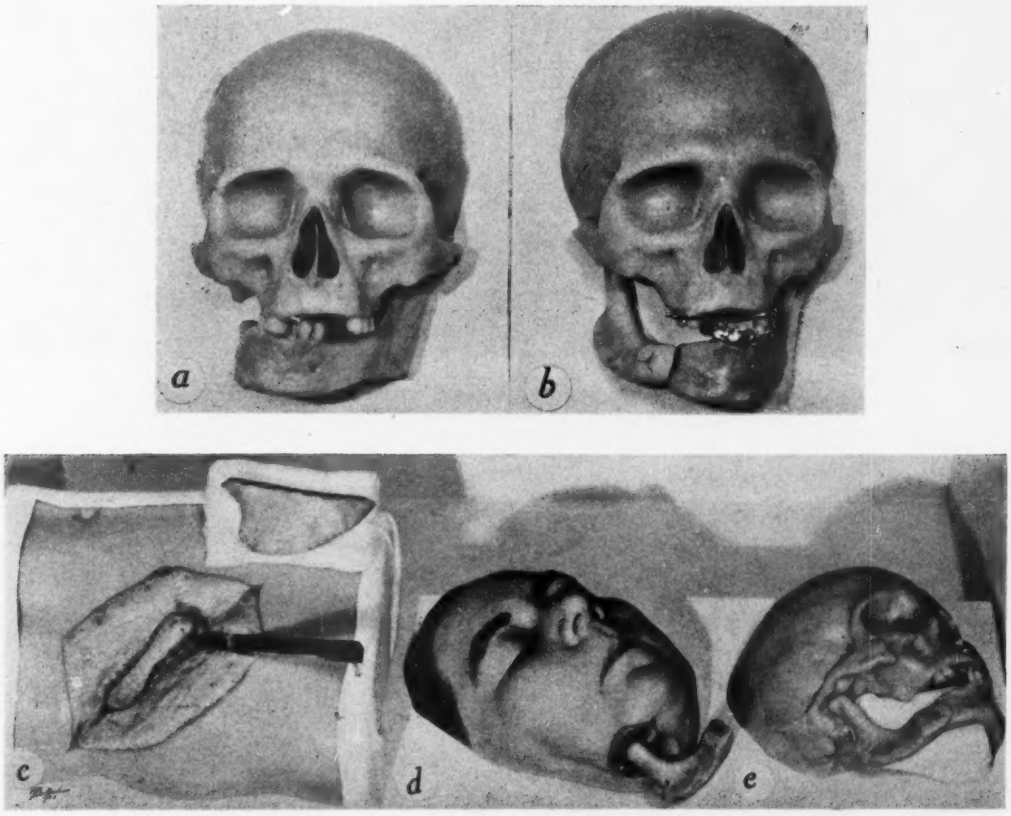

FIG. 11. Loss of the right ascending ramus of the mandible. Defect corrected by means of a bone graft obtained from the ilium. *a*, defect and displacement of the mandible; *b*, appliances for fixation of the mandible in position. The bone graft which has been cut from the right ilium is in place. *c*, removal of a section of bone from the ilium; *d*, the bone graft has been trimmed to the proper size and is being inserted. The anterior superior spine of the ilium makes an excellent angle for the reconstructed portion of the mandible. *e*, bone graft ligated to the free end of the mandible.

to operate during mastication. Under such circumstances, one must consider the use of a prosthesis rather than a bone graft, even though the former is none too satisfactory.

For reconstruction of the ascending ramus and a portion of the body of the mandible, either a rib (Fig. 10) or the crest of the ilium (Fig. 11) can be employed. In our experience, both are satisfactory, although we prefer the crest of the ilium since its anterior superior spine forms an excellent angle for the reconstructed ramus. (Fig. 11*c* and *d*.) As a matter of fact, bone taken from the crest of the ilium can be trimmed to a shape which very nearly of the defect and measurements of the graft must be determined in advance. The soft tissue about the ilium is stripped away until sufficient bone is exposed and, on removal, rongeurs and chisels cut the section of bone to the desired configuration. (Fig. 11.) After the mandible has been immobilized by dental wiring, a small cutaneous incision is made below the free end of the mandible. With a blunt forceps, a tract or cavity is created deep to the masseter muscle, extending from the incision to the glenoid fossa. Technically, this is not difficult to accomplish if one proceeds with caution. Next, the free end of the jaw bone is exposed, ground down

and beveled outward as has been described previously. The graft itself is inserted into this artificially created tract and attached by a catgut ligature to the prepared end of the mandible. A satisfactory functional and esthetic result may be anticipated if the operative procedure is carried out aseptically and if immobilization of the mandible is secured by mechanical devices.

PREVENTION AND TREATMENT OF INFECTION

Since infection is the most serious complication involving bone grafts, this subject deserves considerable attention. Sprinkling a small amount of powdered sulfathiazole or other sulfonamide compound into the wound after transplantation of the graft is to be recommended. There can be little doubt that these drugs aid in overcoming many infections. However, should the wound become grossly contaminated by secretions from the mouth entering through a nick in the oral mucous membrane, one local application of these drugs probably would be ineffectual. Should a definite purulent infection develop about a bone graft, the implant need not necessarily be lost. For such cases, we have found it helpful to insert a small through-and-through rubber tube drain alongside the graft. Usually this drain can be inserted through one draining sinus and brought out through another sinus or counteropening. That part of the tube which is situated within the wound should possess multiple perforations, and this drain is joined externally to a salversan by a Murphy drip connector. By means of this apparatus, diluted solution of sodium hypochlorite (modified Dakin's solution) is permitted to flow very slowly and continuously through the wound for several days. In our experience, this procedure has been definitely effective in saving a few infected bone grafts. It is possible that other solutions such as one of sulfanilamide, if used in a similar manner to irrigate the wound, might produce as good or better results.

From the foregoing discussion, it is evident that despite the refinements of surgical technic which have been developed in recent years, failures of bone grafting still occur. This fact should discourage the indiscriminate use of such transplants to correct every ununited fracture or bony defect of the mandible. Only when the loss of bone actually interferes with dental occlusion and with mastication is there a legitimate indication for the use of a bone graft.

CESAREAN SECTION*

THE RATIONAL USE OF THIS OPERATION

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OF the studies and surveys on maternal mortality that have come and gone during the past decade, cesarean section has almost routinely received unfavorable comment. The question in our own minds as to whether this unfavorable attitude was entirely justified, prompted us to make this study of one hundred consecutive patients coming to abdominal section for delivery in a rural hospital.

Jameson,[1] in a review of obstetrics in northern New York state, several years ago tabulated 5,914 deliveries from a number of different hospitals and found 135 cesareans for that year or an incidence of 2.2 per cent. In this series there were only two deaths in the cesarean patients, or a 1.5 per cent cesarean mortality.

Gustafson[2] reported 366 cases from Indianapolis with a cesarean incidence of 4.8 per cent, and an average cesarean mortality of 8.4 per cent, starting at 18.1 per cent in 1928 and coming down to 2.0 per cent in 1935.

Lynch,[3] from San Francisco, collected a large series of figures from public health reports and found that a quarter of the maternal deaths were in those cases which had had cesareans. His average mortality figure for 12,955 cesareans was 4.1 per cent, with an incidence of 2.5 per cent in 524,117 deliveries.

Stander,[4] in 1935, estimated the average mortality of the operation was around 10 per cent.

Quigley,[5] in 1937, collected 11,994 cases with 526 deaths, or a rate of 4.38 per cent. Of these, his own personal series of 264 cases showed only one death, or 0.3 per cent. The component figures varied from a mortality of 14.6 per cent to 0.

In New York City in 1930, 1931 and 1932, 2.2 per cent of all deliveries were cesarean.[6]

The figures on mortality of maternal cases published from New York, Philadelphia, Indianapolis[7] and Chicago showed that in private practice, cesarean operations were more frequent than in open-ward hospital series, suggesting the effect of economic pressure. But it was also shown that a fifth of the mortality in the New York city series occurred in cases that were submitted to cesareans.

This figure does not, of course, say anything about the number of patients with cesareans that got well, and undoubtedly some of those operated upon would have died without operation. But the gross figures were suggestive, especially to the laity, and perhaps have been one factor in abating pressure on the doctor to "do something" when the patient is in labor and in pain.

Since the publicity given maternal death rates during the past few years, maternal mortality statistics have been better. Death rates for puerperal causes in 1931 was 616 and in 1938, 414,[8] and there is every reason to believe that the present figure is lower still.

The emphasis on obstetrics has been more effective in promoting proper training of the young physician. Maternal morbidity and mortality in the next decade and next generation should be better still.

The improvement in maternal care apparently has come in all its branches. Better prenatal care has been brought to public attention, so that now the patients do come to the doctor earlier; better handling of toxemia and eclamptic patients has lowered the mortality in that list; better and more selective operative methods have done their part as well in reducing mortality.

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There is still room for improvement and all surgeons, obstetricians and general practitioners welcome the criticisms that have arisen, in so far as it gave guidance for better obstetrics in the future.

Cesarean operation in its initial concept seemed to offer immediate solution to many problems that have plagued every obstetrician from the earliest days. As the peritoneal cavity was invaded more and more safely by the surgeon for various and increasingly detailed procedures, it seemed obvious that anatomically, at least, incision of the uterus was a relatively simple matter, and would avoid all the pitfalls that beset delivery through the natural channels.

But the early statistics on cesarean operations showed that the operation itself had its difficulties and that sepsis and hemorrhage were more often encountered than in delivery by the usual methods. So for a considerable period of time, the operation was looked upon as a surgical possibility, but not one that the careful surgeon would attempt without good and sufficient reasons or one in which the risk of delivery in the usual manner was too great. As an operation of last resort, the patients were poor risks to begin with and the mortality was proportionately raised. Therefore, the whole procedure deservedly was held in bad repute.

During the past few years in the Mary McClellan Hospital, a rural hospital of one hundred beds, a hundred cesareans have been done without maternal mortality. (Table 1.) These have been done by the writer or by two other men under his direct observation and, therefore, represent a standard technic of procedure.

Table 1

Number of deliveries	2192	
Number of cesareans	100	
Cesarean incidence	4.4	%
Maternal cesarean deaths	0	
Maternal mortality	0	%

During this time there were 2,192 deliveries with a cesarean incidence of 4.5 per cent.

The fact that a series of one hundred cesarean operations can be done without mortality seems definitely encouraging and would tend to put cesarean operation in a more favorable light. Where there is need for such an operation, we believe this series proves that it can be done. Any operation is associated with a certain risk and any surgeon, if he operates long enough, will encounter several of the many unaccountable accidents of surgery; but the risk in this operation should be no more than in many other more standard procedures.

Technic. The technic of operation at our clinic is undoubtedly similar to that used elsewhere. We have no "secret" methods. We wish to emphasize that good results follow care in the ordinary details of surgery.

The patient is prepared in the usual manner with the exception that we are careful not to give morphia or other sedatives for the few hours immediately before operation. We believe that morphia especially and other sedatives to a lesser extent do cut down the respiratory activity of the fetus, and a few cases of fetal asphyxia may have been due to this factor. This withholding of sedatives is admittedly in marked contrast to our practice and the practice of surgeons generally for operations of other types in which preoperative sedatives are grateful.

Our anesthesia is usually nitrous-oxide-ether. This is quick and the patient goes under with a minimum of difficulty. The mother and baby receive plenty of oxygen. At the time of birth of the baby the oxygen can be raised or the ether practically cut off so that the baby usually breathes promptly. After operation is completed, the patient is given whatever sedatives are necessary.

The abdomen is incised in the mid-line. Ordinarily, the incision is between the umbilicus and the symphysis; but if this distance happens to be short, we do not hesitate to go above the umbilicus. At about the time the uterus is exposed, an ampule of pituitrin is given hypodermically, which induces the uterus to contract at about the time it is incised. A transverse flap is dissected free over the lower portion of the uterus, separating and protecting the bladder from injury, and giving an addi-

tional flap over the lower end of the uterine incision. The uterus is then incised in the mid-line as low as is convenient, but usually with about half of the incision above and half below the level of the transverse flap.

An effort is made to prevent gross contamination of the peritoneal cavity by the amniotic fluid, by using suction, or by using pressure of the hands on the sides of the abdomen as the amniotic sac is opened.

If the incision is low and small enough to allow the baby's head to go through, there will be no need for "walling off" and the intestines, etc., will not be exposed. Postoperative adhesions should therefore be few; but if the omentum is available, it is pulled into the field over the uterine incision before the abdomen is closed.

The baby is extracted by the feet; the uterus will probably be torn a bit if the baby is large but the tear can be repaired as readily as an incision and bleeds less. The cord is clamped and cut and the placenta expressed. The vertical incision is repaired with several layers of continuous chromic catgut. The transverse flap is then reapproximated over the lower portion of the incision and the abdomen closed in the usual fashion.

Postoperatively we have found that a tight Scultetus binder holds up abdominal tension, prevents intestinal distention, and gives the patient great comfort for the first week postoperatively. If distention once develops, it is difficult to control but must be cared for by the usual methods, and often is an index of subclinical peritoneal infection.

The type of operation, we believe, is of lesser importance than the way in which it is done. DeLee's low cervical operation is a good one, but DeLee was a good technician, and his operation really called attention to good technic. An incision in the mid-portion of the uterus is usually more convenient than one either too high or too low; it avoids important structures so that it can be repaired more readily and it heals well.

Extraperitoneal cesarean section has been described and the fact that it can be done is a tribute to the operator's skill and anatomical knowledge. But it is technically difficult and not well adapted for routine use. The exposure is inadequate and the occasional operator might well run into trouble or else violate the peritoneum, spoiling the whole intent of the scheme. Our series does not include any extraperitoneal operations.

Our series does include one Porro cesarean or hysterectomy after cesarean, occurring in a rupture of the uterus. Probably this should be classified primarily as a hysterectomy instead of a cesarean. This is a rare accident of obstetrics but the possibility must be kept in mind.

In this series, we had four still-births and eight neonatal deaths. (Table II.) This seems high and most of these did occur in the first half of the series before our ideas on the general subject had crystallized. But one still-birth followed rupture of the uterus, the accident occurring before admission to the hospital, another in a severe eclamptic condition and two others in premature separation of the placenta.

TABLE II

Number of births	100
Still births	4
Neonatal deaths	8
Causes of Still Births	
Rupture of uterus	1
Eclampsia	1
Premature separation of placenta	2
Total	4
Causes of Neonatal Deaths	
Malformations	2
Prematurity	4
Unaccounted for	2
Total	8

Of the neonatal deaths, two had malformations inconsistent with life over any period of time, and four others were premature, operation having been done to avoid further risk in the mother. The viability of the baby in premature separation of the placenta varies with the amount of separation which cannot be accurately determined before delivery. Some of these patients we operated upon, knowing that the odds were against a live baby, but the patient was willing to chance a quick delivery in the hopes that the fetal circulation might still be adequate.

The indications for cesarean operations are given in the textbooks. Clinically speaking, they come down to a relatively few categories. (Table III.)

Table III
INDICATIONS

Dystocia	55
Toxemia of pregnancy	16
Previous cesarean	11
Placenta previa	7
Cardiac disease	4
Elderly primipara	2
Premature separation of placenta	3
Rupture of uterus	1
Presistent transverse presentation	1
Total	100

The most common question is that of disproportion. When the presenting part, usually the baby's head, does not come down into the pelvic inlet at the time labor begins, especially in a primipara, something is wrong; and if the contraindications can be satisfied, cesarean section may be the answer.

Perhaps the baby is too big; perhaps labor should have been induced a few weeks before; perhaps the pelvis is small, which may or may not have been proved by *x*-ray. If the baby's head still rides high after good pains have started, which can be determined usually by abdominal examination without the risk of a pelvic examination, something is at fault. Therefore, the time for action is before the best minutes and hours are lost.

Secondly, placenta previa happens often enough to be seen occasionally in any hospital. There are other methods of dealing with this, all of which have their uses and their advantages in particular instances; but if the baby is viable and if the mother is in surgical condition, cesarean is one of the safest ways out for both. If the baby is dead or if the mother is moribund, do not perform a cesarean operation; the results are just not worth the risk.

Incidentally, a postmortem cesarean section is usually a feeble gesture. The baby, except under most unusual circumstances, dies before the mother.

Toxemia is another question. The treatment of eclampsia is now apt to be more conservative, but it is still true that the syndrome usually is relieved after the uterus is empty. If the patient is a primipara, or if the cervix is long and firm, and if the patient has recovered from the worst stages of her eclampsia and the baby is viable, it may be a relief to get the baby as quickly and as easily as possible, which is via cesarean.

Separation of the placenta is another complication that occurs more often than the textbooks indicate.

If the fetal heart is good and the baby is not too small, cesarean may save it before the blood supply is further cut off; while delivery in the normal manner, taking much more time, might prove too much for the already damaged circulatory supply. We have had fetal mortality when we guessed wrong on this question, but I am sure we have saved several babies that would have had little chance otherwise.

Previous cesarean is an indication that is relative but usual. A few of our former cesarean patients have delivered themselves normally before we had a chance to do any further investigating. But usually the worry about the scar in the uterus is enough to make any surgeon advise cesarean again if the patient has had one, no matter what the original indication may have been. One or two of our patients have had four; quite a few have had three; and there is no reason why they could not have more cesarean sections but most of them do not.

This factor does influence the decision in the younger patients; for if they have this form of operative delivery once, they may have to have it again which may be awkward, inconvenient or even dangerous. On the contrary, an elderly primipara may have a cesarean on less rigid indications for she may never have another pregnancy.

Intercurrent disease, tuberculosis at a minimal stage, heart disease, or uterine fibroids and the like, may occasionally be indications; and if the risks one way or the other can be medically balanced, the operator should be able to reach a decision with a calm mind.

On the side of the contraindications, cesarean section should be avoided when the patient has been in labor so long as to be physically tired out, or has had several or many pelvic examinations or even a trial of labor or forceps, or has a fever on admission. Even though she may have been under inadequate care in her own home, where factors could not be controlled, do not "stick out your own neck" just to take the burden from the shoulders of the attending obstetrician.

Cesarean section in the past got poor results because it was saddled with many of the poor risk cases, the "failed-forceps" cases, or the cases in which the patients had been in labor for lengthy periods under poor surroundings. Remind yourself of this occasionally and keep your own mortality rate down.

If at all possible, a definite plan for the operation or at least for its consideration should be made. If the pelvis seems narrow to external examination, it can be checked by *x*-ray. Roentgenographic pelvimetry is becoming more standardized and does give real information.

In the border-line case, the patient may be allowed to go into labor, even allowed to rupture the membranes, but in our series we found that the rise of temperature postoperatively seemed definitely correlated with the length of time labor had been under way. Therefore, the decision should be made fairly quickly. (Table IV.)

TABLE IV

MORBIDITY

Number of patients with fever to 100.4°F.	33
Number of patients slightly toxic	20
Number of patients moderately toxic	8
Number of patients severely toxic	5

Causes of Morbidity in 33 Cases

Prolonged trial of labor	38.4%
Unknown	23.
Placenta previa	15.4
Eclampsia	15.4
Pyelitis	7.7

Ryder[9] reported 330 cases from the Doctors Hospital in New York, which showed a definite decrease in morbidity among those patients operated upon before labor really developed. Ryder in this series showed more morbidity in the low-flap operations than in the classical, which proves that there may be two sides to the question in spite of the widespread recognition of DeLee's operation.

The advent of the sulfa drugs in surgery gives a considerable increase in the feeling of safety. Intraperitoneal sulfathiazole and sulfanilimide in our hands has greatly diminished the morbidity and mortality in other diseases as appendicitis and perforated gastric ulcer. There seems no reason why these drugs should not be used intraperitoneally in potentially infected cases. Probably actually infected cases should not be risked with our present knowledge but the border line is obscure. In our own series, we used sulfathiazole by mouth in one case with good results, the fever reaching 101°F. on only one day.

From this study, we gain the impression that when the conditions can be rightly satisfied, cesarean section offers an opportunity to avoid many of the complications associated with a difficult labor. It is necessary to stay between the two extremes, not offering cesarean as a method for all patients, and on the other hand, not delaying too long or neglecting the opportunity for cesarean when it might have been useful. In competent hands, in circumstances in which the technical details can be adequately cared for, cesarean section offers less risk than many of the more difficult and technical obstetrical maneuvers invading the uterine cavity from below. In this series, we have never been sorry that we did a cesarean operation; rather there are other patients for whom we wish we had elected this operation in time.

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CARCINOMA OF THE GALLBLADDER

A CLINICAL AND PATHOLOGIC STUDY

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IN 1777, Stoll of Vienna published the first authentic record concerning primary carcinoma of the gallbladder with necropsy data in two cases.[2] Since that time approximately 2,000 cases[2] have been added to a growing literature in which for the most part the factors of etiology, incidence, association with cholelithiasis and various peculiar pathologic features of the lesions have been stressed. However, the progress made along the lines of early recognition of carcinoma of the gallbladder has been disappointing. Numerous articles bear testimony to the fact that the condition is insidious in its onset and often reaches a stage beyond the scope of surgical removal before it becomes clinically manifest as a malignant condition. For this reason it was considered worth while to report the clinical and pathologic data gleaned from a study of seventy-seven cases of relatively early primary carcinoma of the gallbladder in which the gallbladders were removed surgically at the Mayo Clinic from 1907 to 1940 inclusive.

MATERIALS AND METHODS

Clinical records in seventy-seven surgical cases of carcinoma of the gallbladder were secured and carefully analyzed for pertinent clinical and laboratory data and surgical end results. The pathologic specimens then were obtained and studied carefully in gross detail. In two cases specimens were not available for pathologic examination. In sixty-five of the seventy-five cases in which specimens were available the entire gallbladder was studied. Special attention was paid to the site, size and consistency of the lesion, the presence of regional lymph nodes and any adventitious tissue, the presence or absence of gallstones and so forth. These data were all carefully recorded. Multiple blocks of tissue were then cut from the primary lesion, surrounding uninvolved portions of the wall of the gallbladder, regional nodes and adjacent hepatic tissue when available. These blocks were placed in 10 per cent solution of formalin and cut with a freezing microtome; the sections were fixed with hematoxylin and eosin. When indicated these same blocks were further treated by the paraffin method, sectioned and mounted after treatment with special stains. In all more than 300 sections were made available for study.

CLINICAL DATA

Incidence. The gallbladder is by far the most common site of carcinoma of the biliary passages. It ranks about fifth in frequency of gastrointestinal malignant lesions and comprises about 5 per cent of all malignant lesions. In 33,500 operations on the biliary tract performed at the Mayo Clinic in the years 1907 to 1940, inclusive, there were 291 cases of primary carcinoma of the gallbladder, an incidence of 0.87 per cent. In seventy-seven (26.5 per cent) of these cases removal of the gallbladder or a large portion of the gallbladder was possible.

Age. Carcinoma of the gallbladder has been reported to occur most frequently in

the sixth decade of life; 45 per cent of our series of patients were in this decade of life. The youngest patient in the series was twenty-nine and the oldest was seventy-four years of age.

Sex. Almost invariably reports of carcinoma of the gallbladder indicate that women are affected more often than men. This observation is to be expected owing to the predominance of cholecystic disease in that sex. In our series there were sixty-one women and sixteen men, a ratio of approximately four women to each man.

Stones. The long history of colicky attacks of pain obtained in a large number of cases of carcinoma of the gallbladder (58.5 per cent of our series) favored the presence of stones as possible precursors of carcinoma in the gallbladder. MacCarty, in reviewing the pathologic material from 29,701 gallbladders removed surgically at the Mayo Clinic, found that the incidence of cholelithiasis varied directly with the degree of inflammation present. Although gallstones are not a specific cause of carcinoma, it does seem probable that repeated trauma and chronic irritation due to their presence may be a contributing factor. In 88 per cent of our cases stones were associated with the carcinoma. Much work has been done on the experimental production of carcinoma of the gallbladder but the results of those claiming successful accomplishment of this have been questionable.

History Symptoms and Findings. The past history, owing to the frequency of associated lithiasis, was in many cases of our series, one of previous colics. In a smaller group of cases the history consisted of a vague story of gaseous indigestion, intolerance to fatty and rich foods, and so forth. In about 80 per cent of our seventy-seven cases the past history was suggestive of a pathologic lesion in the gallbladder; the duration of the symptoms averaged 14.2 years. At the time of examination at the clinic the patients could be divided clinically into five rather distinct groups similar to those of Boyce and McFetridge as follows: (1) thirty-six patients (46.8 per cent of the total) who had had colicky attacks for many years with superimposed symptoms suggestive of malignancy; (2) nine (11.7 per cent) who had had colicky attacks for many years without any recent change in symptoms; (3) thirteen (16.8 per cent) who gave a history of gaseous dyspepsia of long duration with superimposed symptoms suggestive of malignancy; (4) three (3.9 per cent) who gave a history of gaseous dyspepsia for a long time but did not report a recent change in symptoms and (5) sixteen (20.8 per cent) who had not had any symptoms referable to the gallbladder prior to the present illness. When overlapping occurred the case was considered in only one clinical group.

The phrase, "the symptoms are suggestive of malignancy," means that they are compatible with, but certainly not associated exclusively with a malignant process. The same symptoms are often associated with benign cholecystic disease.

Analysis of the early symptoms in our group of cases revealed nothing which could not be attributed to the presence of chronic inflammation of the gallbladder, with or without cholelithiasis. However, 80.3 per cent of the patients had noted a definite change in symptoms of relatively short duration. This change in the character of symptoms which had been present for an average of 14.2 years seemed to be a more important diagnostic factor than any particular clinical symptom in the early stages of the carcinoma.

In 71 per cent of the cases the present illness was of less than six months' duration; the average length was approximately four months. The present symptoms in order of frequency with which they were elicited were as follows: pain in 76 per cent of cases; loss of some weight in 67.5 per cent; dyspepsia in 27 per cent; weakness in 23.4 per cent; anorexia in 18 per cent; jaundice in 13 per cent; constipation in 11 per cent and nausea and vomiting in 10 per cent.

Pain. In approximately half of the cases in which pain was present the pain was colicky and in the remaining cases it was constant. The latter group includes a number of cases in which at the onset of the illness colicky pain had been present and a constant pain later developed. Patients who gave a past history of colicky attacks of pain frequently complained of some change in the attack such as increasing frequency and increasing severity or duration of the attacks of pain or one of these changes. The steady type of pain varied from an annoying mild ache (in seven cases) to a severe steady pain requiring sedation for relief. In most instances the pain was limited to the right upper quadrant of the abdomen but in some instances extended into the back and right shoulder and in one instance to the right groin.

Loss of Weight. In thirty-eight cases in which loss of weight was a presenting complaint the amount lost varied from ten to seventy pounds (4.5 to 31.8 kg.) and the duration of the complaint varied from three weeks to two years. The average loss was nineteen pounds (8.6 kg.). In four cases the only complaint of recent onset was that of loss of weight. That this can be associated with cholecystitis was shown by Deaver and Bortz; however, the percentage of patients who gave this complaint is decidedly smaller than that of patients who have early carcinoma of the gallbladder.

Dyspepsia. Gaseous dyspepsia, belching or flatulence were complained of in 27 per cent of our cases; this incidence is similar to that usually reported in cases of benign cholecystic disease. The dyspepsia was usually of recent onset and in most cases it had been present for less than seven months. In most instances the gaseous dyspepsia followed, within a short time, the ingestion of food.

Other Symptoms. Only brief comments will be made on the various other symptoms mentioned by the patients. Weakness was as a rule gradual in onset and in only two cases was it marked. The duration of the complaint varied from ten days to one year. Anorexia was present in eighteen cases and in two additional cases there was marked intolerance to the ingestion of food. Jaundice was present in ten cases (13 per cent) and varied in duration from one day to five months. In two cases it was of the painless variety and was due to invasion of the common duct in one case and to pressure of a mass on the duct in the other. Nausea and vomiting had occurred in only eight cases and were marked in only one instance. Three patients reported feeling a mass in the abdomen for from three weeks to three months prior to examination. Constipation of recent onset was present in 11 per cent of the cases and in one case there was an intermittent diarrhea of three months' duration. Ascites which was present in one case was due to portal obstruction caused by a mass along the common duct.

Physical and Laboratory Findings. A tumor was palpable in 40 per cent of the cases; the largest tumor was the size of a grapefruit. In most instances the tumor proved to be a greatly distended gallbladder. In 23 per cent of cases the liver was palpable and in two instances it extended well below the umbilicus.

Tenderness over the right upper quadrant of the abdomen or in the epigastrium was found in more than half of the cases in this series and in one instance it was noted at McBurney's point.

In thirty-five of forty-four cases in which the leukocyte counts were recorded they were less than 10,000 per c.mm. of blood. The highest recorded count, namely 29,800, was recorded in the case of a woman, aged sixty-two years, who had a perforated gallbladder. In most instances an elevated count was associated with a recent attack of acute cholecystitis. The value of hemoglobin in thirty-two of forty-six cases in which it was recorded was greater than 75 per cent. The lowest value, 54 per cent, was that of a man, fifty-eight years of age, who had carcinomatous invasion of the liver. A low

fever was present in several cases. In no instance was the diagnosis of carcinoma made on roentgenoscopic examination.

PATHOLOGIC DATA

Gross studies of the entire gallbladder were made of sixty-five available specimens. In twenty-six cases (40.0 per cent) the gallbladder was distended to four times its normal size; in approximately a quarter of these cases empyema of the gallbladder was noted. In an additional eight cases (12.3 per cent) the gallbladders were enlarged and the wall markedly thickened. In seventeen cases (26.1 per cent) there was no appreciable enlargement of the gallbladder but the wall was found to be markedly thickened. An hourglass deformity was present in seven cases (10.8 per cent) and in an additional seven cases (10.8 per cent) a markedly thickened and contracted gallbladder was found.

Grossly, the mucosa in twelve cases showed papillary ingrowths. The site of the carcinoma was always represented by thickened mucosa wherever the wall of the gallbladder was involved. If the involvement was not too extensive, there was usually a rather sharp line of demarcation between the carcinoma and surrounding mucosa; this was not only visible but evident on palpation.

The site of origin of carcinoma of the gallbladder is commonly thought to be in the fundus; however, Judd and Gray did not find this to hold true. In our series a definite site was obtained in forty-eight of the cases. In 54 per cent of these cases the point of origin was in the region of the fundus; the origin in 27 per cent was the midportion and in 19 per cent the neck of the gallbladder.

The largest carcinoma encountered measured 7 by 5 by 6 cm. and the smallest was 2 mm. in diameter.

Visible Metastasis or Direct Extension. Visible metastasis or direct extension beyond the confines of the gallbladder was present in forty-eight (64 per cent) of the seventy-five cases in which these factors were ascertained. In 28.2 per cent of the group in which metastasis or extension or both occurred metastasis alone was exhibited, in 43.6 per cent direct extension alone, and in 28.2 per cent both extension and metastasis. From this small series it would appear that direct extension occurs more often and earlier than metastasis; however, as the regional nodes were not routinely removed for biopsy the figure for metastasis may be low. Also it is likely that metastatic lesions too small to be visible were present in at least a few of the cases.

Sites of metastasis were as follows: liver in 73 per cent of cases; regional nodes in 61 per cent; pancreas in 15.3 per cent; omentum in 3.8 per cent and ovaries in 3.8 per cent. Sites of direct extension were the liver in 67.5 per cent of cases, ducts in 15.1 per cent, duodenum in 12.1 per cent, colon in 6.0 per cent, omentum in 3.0 per cent and abdominal wall in 3.0 per cent.

In 41.0 per cent of the seventy-five cases carcinomatous involvement of the liver had occurred and in 29.2 per cent carcinoma had involved the lymph nodes.

TABLE 1
METASTASIS ACCORDING TO GRADE OF LESION

Grade	Total Cases Studied*	Metastasis, Cases	Per Cent of Total Cases of Each Grade
1	20	4	25.0
2	25	16	64.0
3	18	16	88.8
4	12	12	100.0

* Cases in which the carcinoma was of mixed grades are listed under the higher grade of lesion.

In seventeen cases the carcinoma was limited to the mucosa and submucosa without penetration through the muscularis. Sixteen of these were classified as grade 1 and one as mixed, grades 1 and 2. It appears from Table 1 that the frequency of spread beyond the confines of the gall-

bladder varies directly with the grade of the carcinoma.

Grossly, the carcinomas were evenly divided between the villous and the infiltrating types.

Microscopic Findings. In seventy-five cases in this series specimens were available which were suitable for microscopic examination. Sixty-four (85.3 per cent) of the carcinomas were of adenocarcinoma type. There were two cases of squamous cell carcinoma (2.7 per cent) and nine of mixed adenocarcinoma and squamous cell carcinoma (12.0 per cent), the so-called adeno-acanthoma.

Table II
GRADE OF LESION IN 75 CASES

Type of Lesion	Grade	Cases	Per Cent of 75 Cases
Adenocarcinoma.....	1	20	26.7
	2	18	24.0
	3	8	10.7
	4	9	12.0
	mixed		
	1 and 3	6	8.0
	1 and 2	3	4.0
Adeno-acanthoma.....	1	0	
	2	2	2.7
	3	4	5.3
	4	3	4.0
Squamous cell carcinoma.....	2	2	2.7
All types.....	1	20	26.7
	2*	25	33.3
	3*	18	24.0
	4	12	16.0
	1 and 2	45	60.0

* Cases in which the carcinoma was of mixed grades are listed under the higher grade of lesion.

Grading was done according to the method of Broders (Table II). In 60 per cent of the cases the carcinoma was of grade 1 or 2. As our series is a selected group this figure should not be taken as proof that carcinoma of the gallbladder is as a rule of low grade.

In three instances malignant change occurred in a pre-existing papilloma. This finding would indicate that papillomas have carcinomatous potentialities.

In one instance carcinoma, grade 1, was found to originate in an adenoma.

In a third of the adenocarcinomas signet ring cells were found. Usually little, if any, mucus was present and in only one instance was a sufficient amount present to warrant calling the carcinoma a mucous type.[6]

A mixture of grades was found in 21 per cent of cases. In every instance the difference between the grades was sufficiently marked to justify such a classification.

In four instances a definite squamous metaplasia was found to be present in the mucosa of a gallbladder in which adenocarcinoma was present. The finding of such regions is fairly conclusive evidence for the metaplasia theory of origin for squamous cell carcinoma. Further evidence is seen in the finding of mixed adenocarcinoma and squamous cell carcinoma (adeno-acanthoma) is 12 per cent of cases. Certainly it seems likely that the same cells may give rise to either an adenocarcinoma or a squamous cell carcinoma.

Mode of Spread of the Carcinoma. That carcinoma spreads locally by direct invasion and distally by way of the blood stream and lymph vessels and possibly, in rare instances, by implantation has long been established.

Perivascular spread of carcinoma was present in twelve (16.0 per cent) of the seventy-five cases. In these cases the involvement was definitely primary, as distinguished from secondary involvement. By secondary perivascular involvement is meant that the vessel is surrounded by a mass of carcinoma which does not show any definite tendency to be localized to the perivascular space.

Intravascular involvement was found in 17.3 per cent of cases. Recently, attention has been focused on the dissemination of carcinoma cells along the perineural lymphatic spaces. Kahler found perineural spread in practicaly all cases of carcinoma of the prostate. Ewing mentioned spread of carcinoma of the gallbladder along the nerve sheaths. In this series such a mode of

dissemination was found in 22.7 per cent of the lesions. Invasion of the nerve proper was present in 5.3 per cent of specimens.

TABLE III
TYPE OF SPREAD

Grade	Perinural	Intra-neural	Peri-vascular	Intra-vascular
1	4	0	0	0
2	5	2	3	4
3	7	2	6	7
4	1	0	3	2

In Table III is given the number of cases of each grade in which these methods of spread occurred. As would be expected the incidence of spread via the routes listed in Table III varied directly with the grade of the carcinoma. In carcinoma, grade 4, the involvement was usually too extensive to permit an accurate determination of the mode of spread; in most cases the spread fell into the so-called secondary classification.

TABLE IV
SUMMARY OF MICROSCOPIC OBSERVATIONS ON MUCOSA OF THE GALLBLADDER IN 65 CASES

Observations	Cases	Per Cent
Increased lymphocyte infiltration		
Minimal	4	
Moderate	50	100
Marked	11	
Fibrosis		
Minimal	18	
Moderate	27	100
Marked	20	
Rokitansky-Aschoff sinuses	33	50.8
Infiltration with plasma cells	28	43.1
Infiltration with polymorphonuclear leukocytes	5	7.7
Hemorrhage	7	10.8
Necrosis	7	10.8

Microscopic Study of the Mucosa of the Gallbladder. The criteria set forth by MacCarty for pathologic changes in the gallbladder were used as a basis in this study. Specimens of mucosa were available in sixty-five cases (84.4 per cent of the total number of cases in the series). It can be seen from Table IV that in each case pathologic changes were exhibited in the gallbladder remote from the carcinoma. In most instances these changes were rather marked. The diagnoses made from observations on the mucosa are given in Table V.

TABLE V
DIAGNOSIS MADE FROM OBSERVATIONS ON MUCOSA

Diagnosis	Cases	Per Cent
Chronic catarrhal cholecystitis	1	1.5
Chronic cholecystitis	24	36.9
Acute on chronic cholecystitis	12	18.5
Subacute on chronic cholecystitis	28	43.1
Total	65	100.0

It can be stated from the observations listed in Table V that carcinoma of the gallbladder never arises in a normal mucosa. In spite of the high incidence of cholecystic diseases found in routine postmortem specimens (75.5 per cent reported by Mentzer and 58.4 per cent reported by Crump) carcinoma of the gallbladder is found in only 0.3 to 0.4 per cent[7] of routine postmortem specimens.

CORRELATION OF SYMPTOMS WITH PATHOLOGIC CHANGES

An attempt was made to correlate the two chief symptoms, namely, pain and loss of weight, with the extent of the carcinoma.

TABLE VI
GRADE AND EXTENSION OF CARCINOMA IN 52 CASES IN WHICH PAIN WAS A PRESENTING COMPLAINT

Grade	Carcinoma, Cases			Per Cent of Total Cases of Each Grade in Entire Series*
	Localized to Gall-bladder	Not Local-ized to Gallbladder	Total	
1	7	3	10	50.8
2	5	14	19	76.0
3	2	13	15	83.3
4	0	8	8	66.7

* Total number of cases of carcinoma of each grade is given in tables 1 and 2.

In fifty-nine cases a presenting complaint was pain, however, in seven cases this pain was mild. These seven cases were eliminated in this correlation. In Table VI fifty-two cases in which pain was a presenting symptom are grouped according to extension of the carcinoma. Thus in thirty-eight (73.1 per cent) of the fifty-two cases in which pain was one of the presenting complaints the carcinoma had extended beyond the confines of the gallbladder.

TABLE VII
GRADE AND EXTENSION OF CARCINOMA IN 38 CASES IN WHICH LOSS OF WEIGHT WAS A PRESENTING COMPLAINT

Grade	Carcinoma, Cases		Per Cent of Total Cases of Each Grade in Entire Series*
	Localized to Gallbladder	Not Localized to Gallbladder	
1	8	2	50.0
2	2	11	52.0
3	1	10	61.1
4	0	4	33.3

* Total number of cases of carcinoma of each grade is given in tables 1 and 2.

The cases in which recent loss of weight occurred are grouped according to extension of the carcinoma in Table VII. Thus in twenty-seven (71.1 per cent) of the cases in which recent loss of weight occurred the carcinoma had spread beyond the gallbladder. It also was found that in 50 per cent of the cases of carcinoma, grade 1, recent pain or loss of weight had not occurred. In only one case of carcinoma of each of the other three grades were both of these symptoms lacking. Six patients who had adenocarcinoma, grade 1, which was limited to the mucosa had lost from fifteen to fifty pounds (6.8 to 22.7 kg.) within a year; two complained of a constant pain in the right upper quadrant.

PROGNOSIS

An attempt was made to determine for each grade of malignancy the average length of survival following operation of patients dying from recurrence of the carcinoma and for those who were still living. Nine patients died within two to twelve days following operation and were not included in the statistics. Also excluded were two who had been operated upon for adenocarcinoma, grade 1, within the last six months of 1940 and six patients who died from causes other than the carcinoma. Three of these last patients had carcinoma, grade 1, two grade 2, and one grade 4. The period of survival according to grade of the carcinoma is fifty-four cases in which follow-up data were available is given in Table VIII. It is interesting that the period of survival in cases of carcinoma, grade 1, was four times that in cases of carcinoma, grade 2. Seven patients who had adenocarcinoma, grade 1, have survived five years or more after the operation. Four of these have survived more than thirteen years. Only one patient

TABLE VIII
SURVIVAL AFTER OPERATION IN 54 CASES IN WHICH FOLLOW-UP DATA WERE AVAILABLE
Period of Survival after Operation

Grade	Period									
	Cases	1–3 Mo.	3–6 Mo.	6–12 Mo.	12–18 Mo.	2 Yr.	3 Yr.	4 Yr.	5 Yr.	Average Mo.
1	13	1	0	1	2	1	1	..	7	78.0
2	17	1	6	3	2	1	2	1	1	18.9
3	13	4	2	3	4	..	..	..	..	6.4
4	11	2	6	2	1	..	..	..	..	5.1

who had carcinoma, grade 2, has survived five years and that patient is alive six years following operation. It is also of interest that one patient with adenocarcinoma, grade 4, of the gallbladder survived for a period of eighteen months following operation. The longest survival of a patient who had carcinoma, grade 1, was twenty-eight and a half years. Of the three patients who had carcinoma, grade 1, and died of causes other than the carcinoma two lived more than five years thus bringing the figure up to nine instead of seven. Thus 45 per cent of the patients who had carcinoma, grade 1, survived five or more years while only one (4.3 per cent) of the patients with carcinoma, grade 2, and not one of those with carcinoma, grades 3 and 4, survived five years. Therefore, it can be stated that adenocarcinoma, grade 1, of the gallbladder, when limited to the mucosa and submucosa has a good chance for a cure. In our series three patients who had adenocarcinoma, grade 1, with invasion of all layers of the gallbladder or metastasis to surrounding structures survived operation by an average of only 7.3 months.

The great difficulty in diagnosing carcinoma of the gallbladder is evidenced by the fact that in no instance was a definite diagnosis made preoperatively.

SUMMARY

Carcinoma of the gallbladder occurs most frequently in the fifth decade of life and is predominantly a disease of women. Stones were associated with the carcinoma in 88 per cent of cases and that they definitely preceded the development of the carcinoma was evident in 58.5 per cent of these cases. An analysis of the early symptoms revealed nothing which could not be attributed to the presence of chronic inflammation of the gallbladder with or without cholelithiasis.

The classification of these carcinomas was adenocarcinoma, 85.3 per cent; squamous cell carcinoma, 2.7 per cent, and adeno-carcinoma, 12.0 per cent. Three instances of malignant degeneration in a papilloma and one in an adenoma were found. The finding of areas of metaplasia in the mucosa and of adenocarcinoma and squamous cell carcinoma in the same tumor lends support to the theory of metaplasia for the origin of a squamous cell carcinoma.

Five-year cures were obtained in 45 per cent of the cases of carcinoma, grade 1, in 4.3 per cent in cases of grade 2 and in none of the cases of carcinoma of the other grades. In no instance was a definite diagnosis made preoperatively.

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MANAGEMENT OF THE EXTERNAL BILIARY FISTULA*

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FOR simplicity, biliary tract fistulas may be divided into two types: mucobiliary fistulas and bile-biliary fistulas. Both are true biliary fistulas in that they communicate with some part of the biliary tract. Not too infrequently, one sees a right upper quadrant fistula which has drained for weeks, months or even years without satisfactory explanation because the problem has not been sufficiently investigated.

Mucobiliary fistulas are those in which there is persistent drainage from the gallbladder following cholecystostomy, incomplete removal of the gallbladder, or spontaneous exterior rupture of the gallbladder. In this type of fistula, the cystic duct is obstructed and the secretion from the mucous pouch or gallbladder must find another means of exit. The story is usually characteristic in that the drainage tract closes, then some weeks later pain, swelling and tenderness develop, to be followed in a few days by release of mucus or mucopurulent fluid. This process may repeat itself again and again. The occasional presence of bile in this fluid may be explained by the valvular action of the cystic duct or neck of the gallbladder which permits a small amount of bile to enter the gallbladder but does not permit it to exit freely through the cystic duct. Again, a small anomalous duct may lead directly from the liver into the gallbladder. Unless an internal communication develops to permit drainage or the secreting mucosal wall is destroyed, the repetition will continue. Although one can sometimes reason out the mechanical problem in such a case and then proceed to correct it by proper removal of the gallbladder, it is far better to visualize[1,4] the mechanical and pathologic problem by injecting a radiopaque substance such as 40 per cent hippuran or diodrast into the fistulous tract. Usually, some obstructive agent such as stone, mucous plug, blood clot, organized débris, or possibly stricture will be found occluding the cystic duct. The cystic duct obstruction was released in two instances by repeated irrigations with normal saline and warm olive oil in conjunction with antispasmodics by mouth. In one case, $\frac{1}{50}$ gr. of atropine dissolved in a little warm water was instilled into the tract in the hope that it might aid in relaxing the musculature of the neck of the gallbladder and cystic duct. Although the obstruction was released, the part played by the atropine solution cannot be estimated. On two occasions, Pribham's[8] method of instilling 5 cc. of a mixture of $\frac{2}{3}$ ethyl ether and $\frac{1}{3}$ ethyl alcohol was not successful in disintegrating the stone within the cystic duct, but this method should be borne in mind.

Cholecystoscopy, which Hollenberg and Eikner[6] accomplished by passing a cystoscope through the drainage tract, is certainly an ingenious procedure and is occasionally indicated. In one instance, I substituted an infant size proctoscope by enlarging the drainage tract slightly and injecting a little air, but could see nothing to be removed. If the cholecystogram reveals a stone and a patent cystic duct in a patient who has declined operation or is a poor operative risk, this stone, which frequently acts as an undesirable, foreign free body, could be removed by cholecystoscopy. However, in most instances cholecystectomy with or without exploration of the common duct becomes necessary.

The bile-biliary fistula is usually a sequel of some operative procedure upon the gallbladder. It frequently follows a cholecys-

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tectomy during which the common duct has been injured, or more frequently when there is a remaining stone, tumor, blood clot, mucous plug or organized débris obstructing the common duct.[1,2] At other times, spastic biliary dyssynergia[4] may obstruct the flow of bile and produce sufficient back pressure to break through the ligated cystic duct. Again, the ligature may slip off the cystic duct and even though the common duct is not completely obstructed, there may be enough resistance that the bile finds easier egress through the drainage tract.

If bile drainage begins several days after operation, is rather profuse at first and then gradually diminishes and ceases, the ligature on the cystic duct has probably failed in its purpose by cutting through, absorbing too early, or coming loose. If bile flow is profuse and continuous, common duct injury or some obstructing agent in the common duct should be suspected. When profuse drainage persists after removal of the common duct T-tube or catheter, there is usually some obstruction in the duct such as a stone, tumor or choledochal spasm. Under no circumstances, therefore, should a T-tube or catheter be removed before a delayed cholangiogram has been obtained, but since this is occasionally done, the subject will be discussed.

After drainage has persisted for a week or ten days without much decrease, a delayed cholangiogram should be made by injecting about 30 cc. of 40 per cent hippuran or diodrast solution into the sinus tract. Either the syringe tip or the inserted rubber catheter is held in such a manner that the opaque medium cannot return. An *x*-ray is taken immediately and repeated in ten minutes, keeping the fistulous tract blocked with a gauze pack during the interval. Following this, some of the contrast medium should be allowed to escape from the tract and another *x*-ray taken ten minutes later. The first ten-minute interval with the external exit blocked permits the contrast medium to escape under the existing pressure into the duodenum, if possible. The second ten-minute interval with the external exit open, permits some of the contrast medium to escape externally, and possibly because the opaque medium is then less dense, a stone or some other obstructive factor may be seen which was previously obscured by the excess contrast medium. Under no circumstances should a final conclusion be drawn regarding the status of any biliary fistula until a cholangiogram has been made.

A biliary fistula occurs because the resistance in the common duct or sphincter area is greater than that of the drainage tract or operative wound. The bile takes the course of least resistance and continues to flow through the abnormal tract to the outside until the obstructive factor has been removed. If the cholangiogram reveals only spasm at the lower end of the common duct (so-called spastic dyssynergia), attention should be directed toward relaxing the sphincter area. In such instances it is advisable to place the patient on the same three-day biliary flush that is used for the removal of remaining common duct stones,[1,5] because it uses to advantage most of the agents which relax the sphincter area and tends also to flush out any small foreign bodies that might be a source of irritation to the sphincter area. Following is the outline of this flush regime:

1. 3 decholin or procholon tablets after each meal and at bedtime for 3 days
2. 2 drams of magnesium sulfate each morning
3. 1 ounce of pure cream or olive oil before noon and evening meals and at bedtime
4. First day: $\frac{1}{100}$ gr. nitroglycerin tablet dissolved under the tongue three times a day before meals
5. Second day: $\frac{1}{100}$ gr. atropine tablet in water three times a day before meals
6. Third day: $\frac{1}{100}$ gr. nitroglycerin as on first day
7. The fistula should be irrigated gently each day with warm normal saline solution and after this has completely drained off, 10 to 30 cc. of warm sterile olive oil instilled
8. The fistula should be packed during treatment except for one hour out of six unless

the patient complains of severe pain in which case the pack may be removed for a short time

9. Intravenous decholin sodium may be substituted for the oral method, using one 10 cc. ampule of 20 per cent solution

In a number of instances, the biliary fistula has closed after one or two of these flushes and remained closed without any untoward effects. When spasm appears to be the factor, it is most important to instill warm olive oil for several days, and on at least one occasion to instill a warm iodized oil such as lipoiodine or lipiodol as the latter seem to exert a definite healing and soothing effect. On one occasion, this spastic condition persisted for thirty days, so completely obstructing the flow of bile that the stools were clay colored until finally the instillation of warm iodized oil brought immediate complete relaxation and the patient had no further difficulty.

Should the cholangiogram reveal a foreign body in the common duct, it is doubtful whether the fistula will ever close permanently until the obstructing agent has been removed. The patient should be given the three-day biliary flush, during which time the fistula should be plugged with gauze except for several one-hour periods each day. Releasing bile from the duct for a few hours each day prevents too much back pressure against the hepatic cells with its possible subsequent injury. If the patient experiences a great deal of pain, the packing should be released more frequently during the day. Warm olive oil, warm normal saline, or both, should be instilled into the fistulous tract under pressure each morning. Having the patient dissolve a $\frac{1}{100}$ gr. tablet of nitroglycerin under his tongue just before the irrigation is started, may relax the sphincter area sufficiently to permit better through-and-through irrigation into the duodenum. If the cholangiogram shows the foreign body has not been dislodged after the flush, the patient should be permitted to rest for three days and then the flush should be repeated. In this second flush, intravenous decholin sodium is substituted for the decholin or procholon by mouth, using 10 cc. of a 20 per cent solution each day for three days. There appear to be definite advantages in using this hydrocholeretic in conjunction with the antispasmodics when the oral method has failed to dislodge a foreign body. If the stone is too large to pass through the sphincter area, it cannot be satisfactorily dislodged; but it is interesting to note that although small stones are more apt to be flushed out, there have been cases in which a very small stone or stones could not be dislodged, whereas in other cases stones $1\frac{1}{2}$ cm. in diameter have been recovered from the stool. However, the larger the stone, the greater the difficulty, and also the greater the chance of failure. In one instance, repeated flushes failed to dislodge a small stone from the common duct, a secondary operation was consequently performed and the stone was found frozen to the mucous membrane of the duct. Only with considerable effort could it be removed.

If the flush does not dislodge the obstructing agent, Pribham's[8] solvent or fragmentation method should be tried, instilling about 5 cc. of a mixture of $\frac{1}{3}$ ethyl alcohol and $\frac{2}{3}$ ethyl ether in the hope of disintegrating the stone into smaller fragments that can be washed out with the biliary flush. In twelve attempts with this method, however, I have been successful on only one occasion, even though increasing the amount of solution to 10 cc. at times. Walters[10] reports a successful attempt, and Rafft[9] in a recent article refers to the successful disruption of a common duct stone with pure ether. He also carried out some interesting experiments on animals, proving that many times the process is slow and requires daily instillations for four or five days. He states that provision should always be made for immediate release of the greatly increased intraductal pressure. This can be accomplished very simply in most cases by permitting the plunger to come back into the syringe or by removing the syringe for a few seconds from the fistulous opening or catheter. The amount of pain

the patient experiences is somewhat indicative of the degree of newly built up intraductal and intrahepatic pressure. Raffl suggests that if possible a second small catheter be used to furnish an outlet for gas. He is of the opinion that liver injury does not occur under ordinary precautions and proved there was very little reaction in the cells of the gallbladder, ducts or liver under proper care. The recent work of H. L. Baker, although not germane to the subject of biliary fistula, is of interest in the discussion of ether or ether-alcohol instillations, for he describes a T-tube which could well be used in all common duct operations. The tube has an angle of 45 degrees rather than the usual 90 degrees. A smaller catheter can be passed through it into the duct so the ether can be released directly onto the stone and the gas can escape around the smaller catheter.

On one occasion, I was consulted about a biliary fistula because the cholangiogram revealed a markedly atonic common duct sphincter that permitted a large quantity of digestive juices to enter the duct. This so severely digested the surrounding skin that only by inserting a catheter into the tract and attaching a small electric suction pump could any progress be made in healing the tissues so the fistulous tract could close.

If the common duct is so completely obstructed that no bile, or at the most only a small amount, is reaching the gastrointestinal tract, vitamin K and bile salts should be given by mouth to build up the anti-hemorrhagic factors; for the hypoprothrombin is just as marked in persons with biliary fistulas as in severely jaundiced individuals. For some time, I have been using synkamin, a synthetic substance highly potent in vitamin K activity. This can be given intravenously (1 mg. ampule) two or three times a day and usually within forty-eight hours the prothrombin bleeding time is normal. Given orally, this particular water-soluble vitamin K product does not require the co-administration of bile salts to be effective, but it is my belief that the digestive processes of both the jaundiced individual and the individual with a complete biliary fistula will function better if some form of bile is administered several times daily. One or two 2 mg. capsules are given orally several times a day. The fluid intake should also be closely observed in relation to the abnormal loss through bile drainage. Emphasis must be placed on glucose and protein intake to support liver function.

After all non-operative measures for reestablishing the normal flow of bile into the duodenum have failed, surgery is usually indicated. If the gallbladder is present and cystic duct obstruction is the source of difficulty, cholecystectomy gives most satisfactory results. The common duct should be opened when the patient has been jaundiced, if small stones were present in the gallbladder at the first operation, or when the duct is dilated or its wall thickened. If the cystic duct is patent, a common duct stone has probably been revealed by the cholangiogram, and routine choledochostomy should be carried out with removal of the gallbladder. If, by cholangiography, a tumor such as carcinoma of the duct, papilla, pancreas or duodenum has been found obstructing the lower end of the common duct and this is verified at operation, the Whipple[11] procedure or its modification for resection of the lower end of the common duct, pancreas and duodenum is indicated. An inoperable lesion requires cholecystogastrostomy or cholecystoduodenostomy. If the gallbladder has been removed, choledochoduodenostomy, choledochogastrostomy or choledochojejunostomy is indicated. In all cases of cholecystoenterostomy, no matter which type, the patient should be instructed to take a partial biliary flush the first three days of each month, taking only the decholin or procholon tablets (dehydrocholic acid products), three 3¾[1] gr. tablets before each meal and at bedtime, and omitting the nitroglycerin, atropine, cream and magnesium sulfate. The increased flow of thin, watery bile under heightened pressure af-

fords a definite flushing effect. Since adopting this program, the incidence of chills and fever, indigestion and abdominal distress has so markedly decreased that I am convinced of its definite value. In one instance, the oral method did not quiet down an attack of partial jaundice with its accompanying distress, chills and fever, and 10 cc. of the 20 per cent solution of decholin sodium were given intravenously for three days. This immediately relieved the condition and after taking the oral flush each month for one year, the patient has had no recurrence of symptoms. Just two months ago, she underwent an abdominal hysterectomy and made a very smooth convalescence. There was no opportunity to explore the right upper quadrant at this time because of the low midline incision.

The common duct region is approached by an upper right rectus incision. If a small rubber catheter can be inserted into the fistulous tract to a depth sufficient to reach the common duct, it may be used as a guide in locating the duct. If a catheter cannot be passed, the fistulous tract may be plugged the evening before operation, and the dilated common duct more easily identified at the operating table. In any event, before incising the common duct with the sharp pointed No. 11 Bard Parker blade, the duct should be definitely identified by withdrawing bile through a one-inch No. 22 gauge needle on a 10 cc. syringe. After incision, the stone or stones are removed and a T-tube inserted. If there is any doubt as to whether all of the stones have been removed, a cholangiogram may be taken before closing the abdomen. Under no circumstances should the T-tube be removed before a cholangiogram is taken about seven to ten days following operation. It is my conviction that the end results are better if the three-day biliary flush is prescribed following the removal of any T-tube, to wash out remaining débris and exudate. During the last three years, this has become routine.

A biliary fistula should always arouse suspicion of partial to complete obliteration of the common duct by stricture secondary to injury of the duct. Here again a cholangiogram makes the diagnosis much less difficult. Occasionally, the common or hepatic duct may be completely severed in the course of routine cholecystectomy. If the stricture causes total exclusion of bile from the intestinal tract, the results are disturbance of digestion, disturbance of body chemistry, marked tendency to hemorrhage, loss of weight and strength, and ultimately a condition of osteoporosis. Unless counteractive measures are taken, the condition terminates fatally. It must be kept in mind that a patient with a complete biliary fistula is in just as precarious a condition as a jaundiced individual. With stricture, it has been the usual experience of most surgeons that a local plastic operation is not satisfactory and some type of cholecystoenterostomy as previously mentioned is indicated. At times, reconstruction of the duct over a T-tube will give excellent results. Lately Pearse[7] has made an encouraging report on the use of the vitallium tube in the common duct.

SUMMARY

1. A satisfactory diagnosis cannot be made in cases of biliary fistula until a cholangiogram has been obtained; there can be only suspicion and speculation.

2. The biliary flush by the oral or intravenous method may be of definite value in dislodging obstructing agents or releasing biliary spasm.

3. Ether and alcohol mixture for fragmentation of stones is effective in a few cases.

4. The same measures used to counteract the disturbed physiology in jaundice cases are necessary in cases of complete biliary fistula.

5. Many cases of biliary fistula demand surgery.

6. All cases of biliary intestinal anastomosis should receive the biliary flush once each month.

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The vulva is exceedingly rare as the seat of a primary sarcoma; this is somewhat more often seen as a malignant change in fibroma or nevus.

IMPROVED TECHNIC FOR THE CLOSURE OF A LOOP COLOSTOMY*

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As pointed out by Ochsner[1] as well as other observers, fatalities following resections of portions of the gastrointestinal tract are due primarily to peritonitis. It is true that the number and virulence of the micro-organisms increase directly as the distance from the oral end of the tract. Thus it follows that peritonitis and fatalities would be expected to be more frequent in resections of the large bowel as compared with the small bowel. That this is the case is shown by Shambaugh[2] who noted that in a series of necropsies the incidence of peritonitis was 15.3 per cent in thirty-nine cases in which operations had been performed on the stomach and small bowel, whereas in a group of fifty-two cases in which operations had been done on the large bowel, there was peritonitis present in 33 per cent. There is to be expected a certain minimal mortality in extensive resections of portions of the large bowel. The patient has a severe lesion usually, and in many instances if the lesion were not resected, it would ultimately kill the patient.

Devine[3] has done much to advance the safe resection of segments of the large bowel through the technic of the "defunctionalizing" colostomy.

Prior to the advent of the sulfonamide group of drugs, primary resection and anastomosis of portions of the colon carried a considerable mortality. Even today the intra-abdominal resection and anastomosis of the large bowel is a serious operation, attended by some deaths. Stage operations, in which agglutination between the parietal and visceral peritoneum are used to wall off the area, have found favor in many hands. The Heinecke-Mikulicz and the Lahey-Mikulicz technics are examples of this type of resection.

There have been many ingenious operations conceived in order to make more safe the opening of the gastrointestinal tract within the abdomen without contamination, or creating a fistulous tract to the outside without intra-abdominal soilage. Glassman[5] has done this type of an operation in creating a gastrostomy, and McNealy[4] has done the same in developing his cecostomy. The numerous two-stage types of operations for opening intrahepatic and subphrenic abscesses are examples of the same principle.

For a number of years, the performance of a colostomy consisted essentially of bringing a loop of colon to the outside of the abdomen. These "colostomies in continuity" were then transected, and a rather permanent type of double stomas were left. These were either side to side, in the event that a glass rod or similar structure was used, or they were separated by a portion of the entire abdominal wall. These colostomies were intended for the most part to be permanent colostomies, done usually for an inoperable carcinoma of the bowel distal to that site. If the entire abdominal wall was brought under the loop, hence between the resultant stomas, the technic was a modification of the Mixter type.[6]

Some of these colostomies result from "exteriorization" procedures in which a loop of gangrenous bowel is brought to the surface, and because of the condition

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of the patient no other procedure is done at that time. Also, some of these colostomies have been done prior to reconstruc-

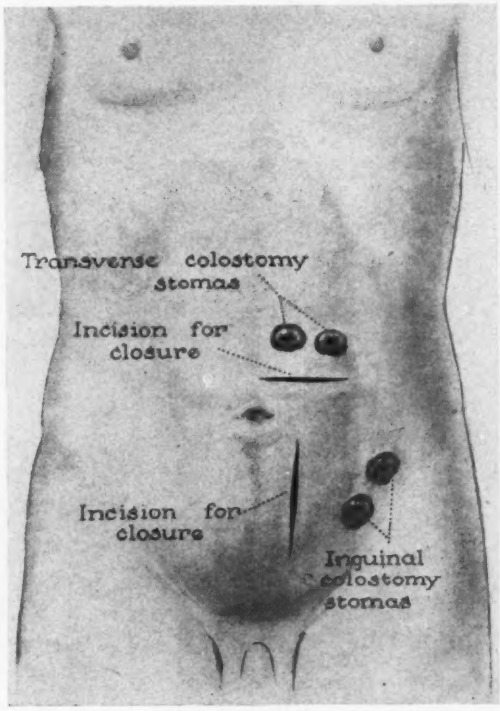

Fig. 1. Incisions used in closure of loop type colostomy.

tion of the immature or absent genitalia in infants. There is also a group that are done on inflammatory lesions which at the time of exploration are deemed to be carcinoma and because of their position or attachment are thought to be unresectable. As Devine[3] has shown, complete side tracking of the intestinal contents, with resultant rest to the affected segment, as surely occurs after transection of a loop type colostomy, may allow the distal inflammatory lesion to heal.

There is then a certain small group of patients who have had a loop type colostomy done, who later wish these colostomies to be closed. Many, of course, done for far advanced carcinoma will never need such closure.

The patient in whom this closure is indicated is ordinarily a well developed, rehabilitated patient, who considers the closure an elective or a plastic procedure which has little or no danger attached to it. This view is held also by many members of the medical profession who do not do any surgery and also by many lay people. It is then particularly distressing to have such a patient develop peritonitis and die from such an operation.

In the event that the mesentery of the colon has been brought to the skin surface, as is the usual case, the closure of this type of a colostomy is a formidable procedure. It represents at best an extraperitoneal end-to-end anastomosis of the colon. There are very few of these, however, that can be done extraperitoneally. It is far more common to have to open up the abdomen to get enough bowel to bring the two ends together satisfactorily. One hears that because of the long standing spillage of feces onto the abdominal wall during the time the colostomy has been functioning, it will vaccinate the patient against his own intracolonic organisms, and that intra-abdominal contamination need not be feared. Also, because of the sulfonamide drugs being so available, it is possible to follow such procedures and then deposit some of these drugs near the anastomosis and have healing and no peritonitis. I believe that these factors are of considerable importance, but I do not believe that either of them should be considered an excuse for open intra-abdominal closure of a loop colostomy. To depend upon these factors in an elective operation, undertaken only for the patient's convenience, seems to be taking a considerable risk.

There is no doubt that the procedure advocated by Pauchet[7] makes a nice plastic closure of these colostomies, and other methods can be used in the open intra-abdominal closure, but fatalities do and have been occurring after such closures.

I have recently utilized a method of closing colostomies of this type with excellent results. I submit it not with any feeling that it is entirely original, as it utilized the principles of Heinecke,[8] Mikulicz,[9] Paul,[10] and more lately of Devine.[11] However, it has some degree of originality

in the order in which these principles are carried out.

It has been my fortune in the past several months to have been confronted with three such loop colostomies which I wished to close. One had had the Mixter type of procedure done, in which the abdominal wall was entirely separating the two stomas; this had been done for a perforated diverticulum of the sigmoid. The other two had only peritoneum and fascia closed between the two stomas. The problem is the same.

I utilized the usual procedure, somewhat after the method of Pauchet[7] for the first of these cases. The skin was freed, the abdominal wall incised, the peritoneum opened by intention, the two limbs identified, and closed with two rows of interrupted silk sutures. Sulfanilamide was placed in the abdomen and the wound closed. On the fourth day postoperatively the patient died, autopsy showing a diffuse peritonitis as the cause of death. There was no leakage of the suture line; the peritonitis was due to the implantation of infection at the time of operation.

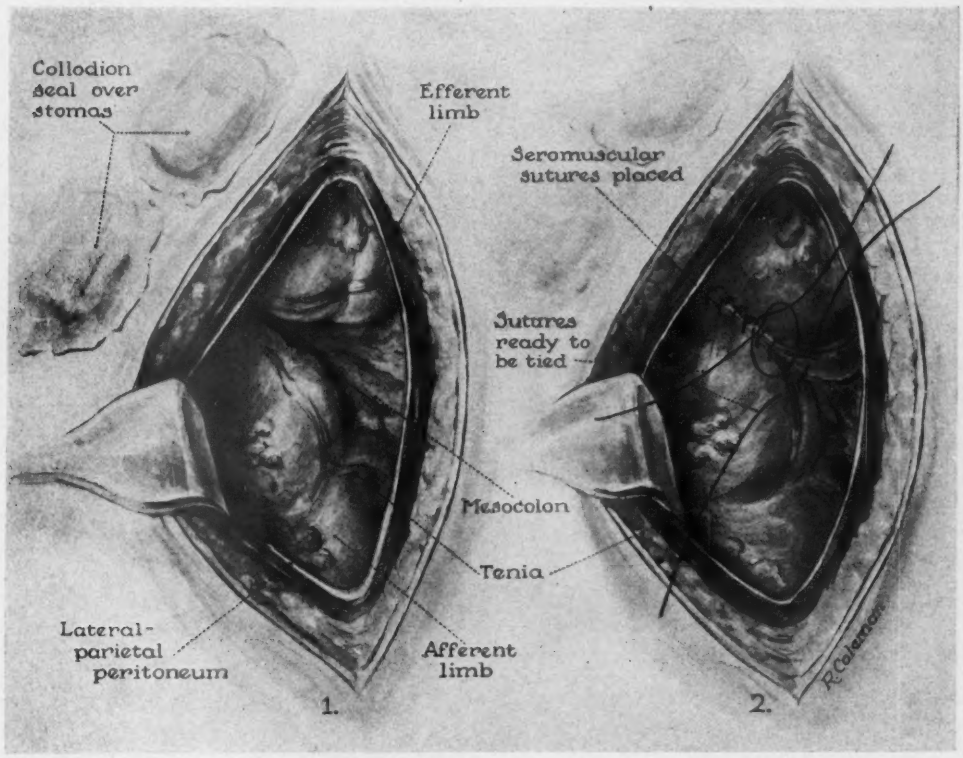

Fig. 2. Intra-abdominal steps in closure of loop type colostomy. 1, Shows appearance upon opening abdomen with visualization of the afferent and efferent limbs. 2, Shows the seromuscular, interrupted sutures placed along the tenia of the two limbs paralleling the limbs.

In the next two cases, I utilized the method to be described with only minimal discomfort to the patients and complete satisfaction in regard to closure of the stomas.

METHOD OF CLOSURE

In this method of closure the essential steps are as follows: The colostomy stomas are cleansed, the two limbs irrigated prior to operation, and the stomas closed with waterproof adhesive, and sealed around the edges with collodion. They are left in place and are undisturbed throughout the operation. The abdomen is opened. The incision which is used is, of course, dependent upon the site of the previous colostomy. It is necessary, however, to make the incision either lateral or medial, or above or below the old stomas, in order to avoid entering the bowel limbs while

opening the abdomen. In the event that the original colostomy was an inguinal type, the utilization of a paramedian incision on the same side will give excellent exposure. The abdomen is packed off with hot lap pads in an effort to keep the small intestine from obscuring the field. Retraction is made on the wound edge toward the colostomy and the two limbs are visualized. Any adhesions which tend to obscure the easy visualization of the afferent and efferent limbs are dissected free so that the serosa of the two limbs of bowel is exposed. The mesentery of the bowel at this point is seen and noted as to whether it is lateral or medial. Usually, unless the loop has been turned, the mesentery will be medial. It is important to note this, as subsequently when the enterotome is utilized this area is avoided. The essential step in the procedure is the paralleling of the afferent and efferent limbs. This is effected by introducing interrupted sutures of silk, seromuscular in depth, from the corresponding tenia of the two limbs. It is of importance to parallel the limbs for at least six inches. Lahey[12] has pointed out the necessity for this step in his description of the procedure for resection of the right colon. One can always have too little spur but never too long a spur. It is essential that this paralleling be continued clear up to the point directly under the parietal peritoneum, to close the point that a loop of small bowel might become enmeshed later and cause an obstruction.

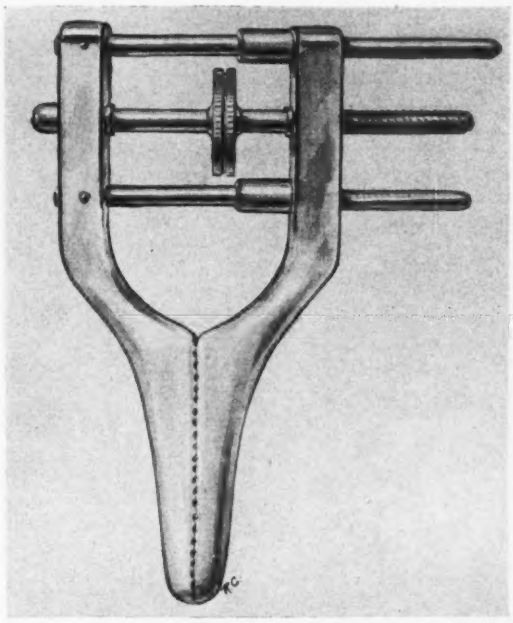

Fig. 3. Ochsner-DeBakey enterotome (full size).

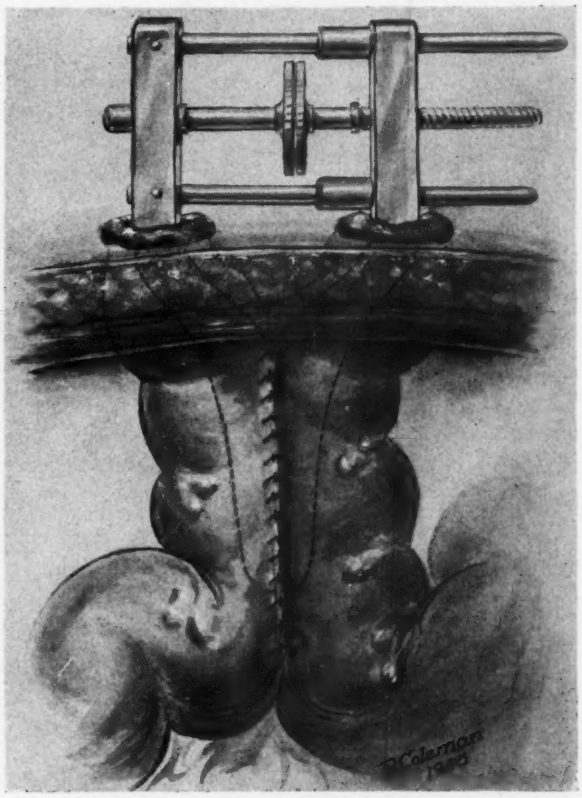

Fig. 4. Cross section showing enterotome in place.

After the two limbs are paralleled in this manner the abdomen is closed. No other procedure is done at this time. The collodion seals are removed later and the patient allowed to convalesce as in any other intra-abdominal operation. After the patient has recovered the spur is broken down. It can be seen that at the conclusion of the paralleling of the two limbs, the patient has in effect the Devine defunctionalizing colostomy. The breaking of the spur can be done as originally described by Devine, with the enterotome he devised, or by the more convenient, short handled, lighter instrument devised by Ochsner.[13] I have used the latter instrument.

After the spur is crushed through the patient will have stools passing through the rectum, and the two original stomas will gradually shrink down and may even completely close. In the event that they do not completely do so, it is a simple matter to free them from the skin and subcutaneous tissue and close them with catgut or steel. This can be done under local infiltration anesthesia.

Reference to the accompanying diagrams will make the steps in the procedure obvious.

There are those that will criticize this method on the grounds that it is not necessary to keep intra-abdominal spillage or contamination from occurring after the long "auto vaccination" period which the patient has had during the functioning of his colostomy. Others will believe that they can prevent serious infection from occurring with the use of the sulfanilamides. To them, I cite my first case.

Others may be of the opinion that this method causes unnecessary delay in closure and will criticize it on that point. To these patients, however, a few days or even weeks is of small moment. They have had their colostomy for months usually and are glad to do anything that will promise them an ultimate closure. The possibility of a fatality from peritonitis is dismissed and this is certainly worth while in such a procedure.

SUMMARY

1. Peritonitis causes the majority of fatalities in intra-abdominal resection and anastomosis of segments of the intestine.

2. The anastomosis or resection of portions of the colon, a portion of the bowel containing virulent micro-organisms, carries a higher incidence of mortality than does the small intestine.

3. Operations designed to prevent spillage into the abdomen at the time of performance of either "stoma" or "entero-enterostomy" procedures have been advocated.

4. Under such headings are the principles of Heinecke, Mikulicz, Paul, Lahey, Glassman, McNealy and Devine.

5. "Loop type colostomies" are used at the present time and may be closed at a later date.

6. The closure of such "loop type" colostomies constitutes an intra-abdominal anastomosis of the large bowel in most instances.

7. Mortality may be high in closure of these colostomies in spite of "auto vaccination" and sulfonamide drugs.

8. A procedure utilizing the paralleling principles of Mikulicz, and also the intra-abdominal characteristics of the Devine colostomy closure is presented.

9. This procedure has been used in two cases with excellent results.

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RAPID REHABILITATION IN THE SHIPBUILDING INDUSTRY

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THE conservation of health, life, limb and productive man-hours is as vital a necessity in the shipbuilding industry as it is for all industry and for the welfare of the nation.

A properly staffed and equipped medical department contributes in a large measure to the correct functioning of the individual and of the group. It is the duty of the medical department not only to select, rightly place and keep the employee physically fit but also to do all in its power to bring about rapid rehabilitation to the sick and injured. In the execution of this responsibility, the medical department serves the applicant, the employee, the management, the insurance carrier as well as the local, state and federal health authorities. Its contacts emanate further to the various industrial departments and department heads, to the hospitals and specialists, to the family and the family physician.

FUNCTIONS OF THE MEDICAL DEPARTMENT

The main functions of the medical department may be classified as follows:

Pre-placement Examinations. This examination should be carefully performed together with the indicated laboratory studies, in a proper appraisal of the applicant for the particular position for which he applies. Today this care in selection and placement is most important since industry, especially a heavy industry, finds it necessary to draw upon every available ounce of manpower. The immediate needs call for the extension of employment to the partially disabled, the young, the old, and the female, in occupations which in peace time were denied to them. Proper placement protects the health of the employee against sudden mishap and insures maximum productiveness. Records of this initial examination will aid in later treatments and decisions should the employee become ill or injured.

Periodic Examination. These examinations are a safeguard against excessive absorption of toxic substances, for those engaged in occupational disease hazards and against progressive physical deterioration of the employee with known disability or of advanced years.

Care of Non-occupational Sick and Injured. In an effort to preserve and keep in the best of condition all available manpower, the medical department also relieves the momentary discomfort of the employee who becomes ill. It renders preventive care and suggests proper health measures for the protection of all workers from infectious and contagious diseases. At the time of the initial treatment for immediate relief the patient is advised to consult his family physician for any further medical care. Generally speaking a patient sent home via the dispensary should return by the same route for a final check-up before resuming work.

Care of the Occupational Sick and Injured. This function produces the greatest volume of work for the medical department and much depends on the proper preventive measures that are taken. Although the safety measures are the responsibility of the safety department, there must be absolute co-operation and co-ordination of the medical and the safety departments to prevent mishap, render medical care when it is indicated and establish a bulwark against the recurrence of accidents. Medical care of the injured includes first aid treatment and investigation at the source of the accident, medical care at the dispensary and adequate hospitalization or specialist's attention when such is required.

MEDICATIONS, TECHNICS AND PROCEDURES EMPLOYED

To keep workers on the job every possible moment, we have developed a few special technics, established certain procedures and adopted new ideas and specific medications which seemed to aid in bringing about the rapid rehabilitation of the sick or injured. Methods which facilitated speedier return to work were chosen in preference to old though established procedures provided satisfactory recovery was brought about rapidly.

The following is an account of some of these technics and procedures followed, as well as a few of the interesting experiences encountered:

Eyes—General. Needless to say, the eyes which are so vital and so indispensable represent a very large percentage of the injury cases, even though the safety department furnishes goggles for all occupations and requires safety glasses when refraction is needed. Every eye case, regardless of complaint is observed for foreign body, and infection or contagion. The hands must be washed before each eye examination and a drop of antiseptic must be instilled at the termination of the treatment. The proper care of the eye demands ready and immediate reliance upon the ophthalmologist and hospital upon the slightest indication.

Eyes—Flash Burns. In an all electric shipyard one of the outstanding sources of eye injuries are "flash" burns or actinic conjunctivitis, caused primarily by the ultra-violet ray produced when the welder strikes his arc. Often the "flash" is not evident at the time when it occurs but a worker may some time after exposure be seized with a severe sunburn of the eyes and perhaps of the face, generally mild, evidenced by itching, burning, redness and photophobia, bilaterally equal and at times reaching such proportions as to cause sufficient swelling of the lids to prevent their opening. This type of case is treated by instilling drop by drop at two minute intervals, a combination of one of the following medicaments which are dissolved in 1:1000 adrenalin, the choice being dependent upon the severity of the condition:

	Per Cent
Pontocaine	½
Butyn	½
Pontocaine	2
Butyn	2
Cocaine HCl	2
Cocaine HCl	4

The latter four are seldom used and then only in severe cases and are supplemented by ice-cold wet compresses. Further relief can be obtained by a thin film of pontocaine ointment or nupercaine ointment. When severe, the pupil is often under spastic constriction which is relieved by the addition of a drop of homatropine solution.

Every welder is given upon request, and especially when needed, a ¼ ounce dropper bottle of specially prepared "Welder's Drops" containing the following prescription:

Pontocaine	¼%
Ephedrine SO_4	¼%
Menthol (Filter)	1/10%
Glycerin	5%
Boric acid sol. qs.	100%

The welder leaves the dispensary having received a final antiseptic of argyrol, neosilvol, mercresin 1:1000 or butyn and metaphen ointment, usually relieved to return to his duties and less frequently to be sent home with a pair of dark glasses. When severe, he is sent home with a quarter-ounce dropper bottle containing pontocaine ½ per cent dissolved in 1:1000 adrenalin to be used as needed.

Eyes—Foreign Bodies. These cases receive the same initial constricting and anesthetic droplet and the same concluding antiseptic droplet as do "flash" burn cases. The majority of foreign bodies are found loose within the lids but many are found superficially or deeply imbedded upon the cornea. Many may have entered hot producing a charred areola. Those which have been on the cornea over

night, become more deeply imbedded and have a succulent grayish-white areola.

Occasionally, a foreign body penetrates the scleral conjunctiva and lies loosely upon the sclera with no indication of the point of penetration. However, by close scrutiny this latter opening may be found.

The foreign body upon the cornea is brushed first with a wet and then with a dry cotton applicator in a direction away from the pupillary area. At times it may be necessary to use the eye spud and if there is a charred or grayish areola the spud is followed by gentle curettage with a bur. Every case having had a foreign body imbedded upon the cornea receives an instillation of 1 or 2 drops of homatropine solution followed by butyn and metaphen ointment and the eye is covered with a pad and patch. The patient is required to return repeatedly until fully recovered. Between ten to twenty-one days after cessation of all medication the patient receives a test of visual acuity which is compared with the record of his vision at the time of employment.

Cases in which the foreign body has lodged itself upon the cornea in the pupillary area are sent directly to the ophthalmologist. In such an injury, having created a possible decrease in visual acuity, it is considered most important not to further traumatize the area with a possible difficult removal of foreign body. These cases require the slit lamp at the hands of an experienced ophthalmologist.

Eye—Infections. We have seen a large variety of eye infections including pink eye, pneumococcus, gonococcus, streptococcus and mixed infection conjunctivitis. We have seen an occasional acute epidemic keratoconjunctivitis with the smear containing lymphocytes and no micro-organisms. The gonococcic, streptococcic and pneumococcic infections have responded rapidly to the application of large quantities of sulfallantoin ointment* which gave no unfavorable reactions.

Eye-Detached Retinas. Occasionally, these cases develop sometime after a blow to the head or the eye. Immediate hospitalization and specialist's care are recommended for any patients who, some weeks after a blow on the head, complain of bizarre types of faulty distorted vision.

Burns—General. It is our belief that there is no satisfactory singular treatment applicable to all burn cases owing to the various types and mixture of degrees of burns and their particular locations. Burns are treated as indicated and our armamentarium includes ointments such as phenol 3 per cent, pontocaine, sulfallantoin, and jellies such as Amertan, tannipaste, etc., and liquids such as foile cod liver oil and A & D ointments. Fairly good results have been obtained by using a mixture of gentian violet and sulfanilamide added to the tannic acid jellies. Occasionally, a macerated sloughing burn requires a wet dressing of normal saline, aluminum subacetate or Dakin's solution. Generally speaking, a nice clean healing of burns has occurred with the vitamin A & D ointments and cod liver oil. Infected burns seemed to be brought under control more easily with wet dressings, sulfallantoin ointment or a sprinkling of sulfanilamide covered by cod liver oil dressings as developed by our Dr. De La Re Signor.

Burns—Infectious. Sulfallantoin ointment is used extensively and freely when the slightest indication of streptococcic infection arises. If a complicating lymphangitis or lymphadenitis occurs, the lymphatic absorption of toxic substances is often arrested by making two or three incisions above the wound and at right angles to the line of lymphatic drainage. These incisions are generally 1 to 2 inches in length and apart. If indicated they go through the subcutaneous tissue and if further indicated the space between is undermined and a rubber dam inserted. The wound itself is not connected by a dam. This same method has been used in rattlesnake bites. A sulfallantoin, bichlo-

* Sulfallantoin Ointment is manufactured by the Schuylkill Laboratories.

ride of mercury or aluminum subacetate wet dressing is applied.

Burns—Extensive, Superficial. These are treated primarily for their discomfort and with antisepsis. Burns with blisters are treated by surgically preparing the part and thorough cleansing with hot soapy water, débridement of all dead skin, and the application of ointment pressure dressings. The dressings are changed as infrequently as possible (even ten to fourteen days).

Fig. 1. Crushed fingers; picture shows hemostats on arteries, lacerated tendons, compound dislocation of joints.

Burns—Weld Burns. These are a common occurrence and leave a deeply punched out area indolently healing by granulation with frequent marginal erosion and excrescence and with a marked tendency to oozing, maceration and secondary infection either giving a localized ugly appearance or an extensive angry cellutitis. At this stage the wound gives a similar appearance to a secondarily infected varicose ulcer and treatment is begun by rest, elevation and wet dressings of aluminum subacetate or bichloride of mercury for twenty-four hours or the use of sulfallantoin ointment.

Dr. G. Hubert Moffses of our staff has devised a method for the treatment of deeply punched out weld burns. A 50 to 50 mixture of sulfanilamide and tannic acid is applied for as short a time as possible over the affected area. The drawback in the use of this procedure is that it requires critical daily observation and withdrawal upon the first indication of excessive caustic action or the occurrence of a dermatitis medicamentosa which may assume extensive proportions. To minimize either reaction and prolong the ability to use this method a 25 to 25 per cent sulfanilamide and tannic acid mixture is prepared by adding a 50 per cent diluent of zinc oxide powder, starch or talc. Better results were obtained when sulfallantoin powder was substituted for the sulfanilamide.

We are aware of the fact that tannic acid has been largely abandoned in the treatment of burns especially in the above mentioned strength but believe that tannic acid has a useful place in the treatment of burns and other lesions when proper selection is made and careful critical observation is followed. Burns always looked cleanest and healthiest when an ointment containing A & D vitamins was used.

Another valuable procedure has been the early surgical conversion of the punched

out molten metal burn by excision to a surgical wound and a straight clean, rapidly healing apposition of skin edges with an ultimate neat, surgical scar instead of the jagged one which would have resulted. For this procedure, the entire bed of the wound must be excised.

FIG. 2. Same hand as shown in Figure 1 as it appeared one week later.

Burns—Molten Metal in Peculiar Locations. Among these the most frequent is the ear with actual burn of the ear drum which may be sufficient to be penetrating or at least cicatricial. The nose at times will be the recipient of a droplet of molten metal. One individual opened his mouth sufficiently wide to have a piece of molten metal lodge on his vocal cord. The ear is treated with auralgan and a pontocaine ointment tampon and as the healing progresses a change is made to boric acid powder or Sulzberger's iodine powder.

Injuries of the Fingers and Toes. Many individuals catch their fingers or toes between pieces of heavy metal. Quite often these fingers are caught in such a manner that amputation would ordinarily be in order but upon closer scrutiny one finds that the nail has been ripped from its base and the soft parts violently torn from their bony attachments. At times the curvature of the finger tips remains in reasonable contour, at other times it may be torn to shreds. Again the bone may be badly splintered or be left reasonably well intact. Surprisingly good results have been obtained by the use of the following procedure:

Anesthesia is by customary nerve block and at times supplementing this by dropping a number of tablets of procaine and adrenalin into the open wound. All bony splinters are removed. The ragged torn edges are carefully brought into their proper position and sutured. This suture must be preceded by a number of unorthodox deep, long-stay or anchor sutures which in healing maintain the normal contour of the finger and hold the soft parts snugly together and to the bone. These sutures quite often are crosswise over the open wound or straight through from the tip and emerge at the region of the distal joint.

If the wounds are freely oozing, sulfallantoin powder is used because of its hemostatic effect. They generally receive an initial thin coating of the ointment for its penetrating effect and are dressed as infrequently as possible. Redressings consist merely of changes in dressings and moistening with alcohol.

The success in these cases seems to be due to the careful apposition of the ragged edges, the maintenance of a snugness of soft parts to the bone by the unorthodox retention sutures, and maintenance of dryness during healing. Occasionally, a finger tip of excellent appearance four to six weeks after healing, has distorted slightly six months later due to constriction of the cicatrix.

This industry is fortunate in having Dr. Hans May, reconstructive surgeon, as a member of its staff. An example of his work is found in Figures 1 to 8. These photographs show extensive lacerations of dorsum of the left hand and fourth and fifth fingers, separation of extensor tendons of

the third, fourth and fifth fingers, compound dislocation of the middle joint of the fourth finger, and the terminal joint of the third finger, and comminuted compound fracture of the terminal phalanx of the third finger. The treatment consisted of excision of wound, reduction of dislocations and fractures, and tenorrhaphy and the local and parenteral administration of sulfanilamide. Figures 5 to 8 show the result five months after the operation.

Many fingers and toes, when crushed, have a painful accumulation of blood beneath the nail. The medical profession is quite familiar with the nail drill which is customarily used to relieve this condition. We, however, have abandoned this procedure entirely. We pay our respects to one of our U.S. Navy trained pharmacist mates who gave us the subtle, painless technic of penetrating the nail by burning. As yet we have constructed no particular

Fig. 3.

Fig. 4.

Fig. 3. Same as Figure 2 taken from a different angle.
Fig. 4. Hand of patient in Figures 1, 2 and 3, as it appeared three weeks after injury showing function of all joints.

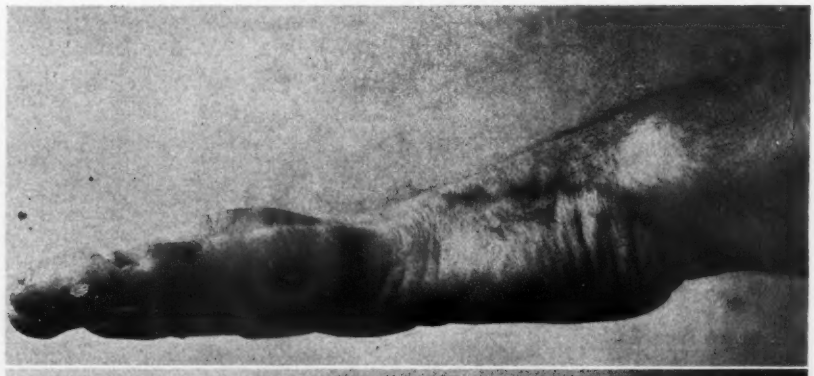

Fig. 5.

Fig. 6.

Fig. 7.

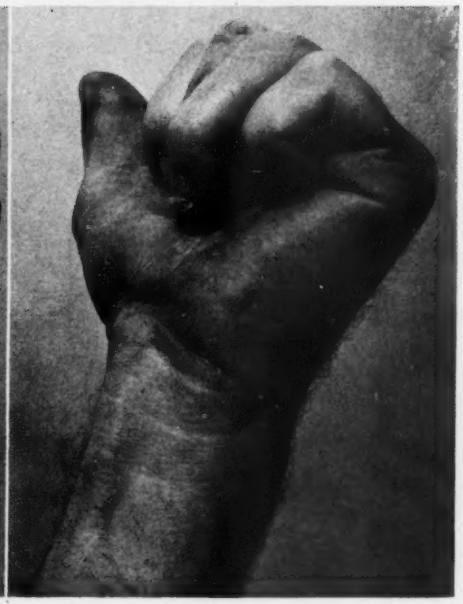

Fig. 8.

Figs. 5 to 8. Four views of hand in Figures 1 to 4 as it appeared five months after operation.

instrument but our procedure is to grasp a large suture needle with a hemostat. The eye end is heated by an alcohol lamp and when quite hot it is brought into contact with the base of the nail and by gentle guarded pressure the nail is immediately and painlessly penetrated. The opening can be enlarged or elongated by repetition of the procedure. The part is given a wet dressing of aluminum acetate, or if infected bichloride of mercury for twenty-four hours. (Fig. 9.)

Fractured Metatarsals. These have been found to heal nicely, rapidly and with least discomfort or disability by having a cobbler fasten a strip of leather one inch wide and one half inch high on the sole of the shoe one inch posterior to and parallel to the metatarsal arch.

Spontaneous Hemorrhage. Peculiarly interesting were cases of spontaneous hemorrhage from the superficial arterioles of the skin. One young individual, while going up the gang plank, felt moisture at his ankle, which was a pulsating bleeding. Another elderly gentleman while walking briskly suddenly saw before him spurting from his cheek a pulsating stream of blood which parabolized to the ground three feet before him. These cases did not develop a subcutaneous accumulation of blood. They were not amenable to arrest except by placing two sutures at right angles to each other through the bed and across the mouth of the opening. None required further treatment other than removal of the sutures. In one case incision to find the bleeding point was unsatisfactory and the incision was closed and the bleeding arrested by the two above mentioned right angled sutures.

Ganglion. The most frequently occurring ganglion is on the extensor tendons of the wrist but we have found these to occur almost wherever a tendon makes its appearance. In place of the former method of striking with a book or of aspiration, we have developed the following procedure. Under local anesthesia the skin and tendon sheath are penetrated with the point of a widely beveled scalpel which is held at right angles to the part and the width of the blade parallel to the length of the

Fig. 9. Blood accumulation under nail; picture shows heated suture needle being applied to penetrate the nail.

tendon. In this manner one will not cut the tendon fibers but split them if the penetration is excessive, although this should not occur. The material wells out immediately and freely and the wound is snugly wrapped. This method has the advantage of complete removal of the material and the sack appears to shrink and disappear. In one case there was a recurrence. The procedure was repeated and permanent recovery occurred.

Bursitis. As reported in a previous paper* "many cases of olecranon bursitis commonly known as "miner's elbow" and prepatellar bursitis known as "housemaid's knee" have been seen. These generally contain a bag or cushion of fluid, either serous, hemorrhagic, or suppurative. Often there is an area of redness, swelling and tenderness, and at times induration, which indicates a superimposed infection. Previous treatments with various ointments, hydrotherapy, electrotherapy, or incision

* Kenneth A. Koerber et al. Sulfallantoin in industrial medicine. *Industrial Medicine*, October, 1943.

and drainage, with iodoform or rubber dam pack, proved to be slow and unsatisfactory. Such cases have been so numerous

Fig. 10. Bursitis; olecranon bursitis before incision.

that we have developed a definite technic of treatment:

"Our scalpels all have a slit in the handle. Into this slit is inserted a rubber dam about 1 in. by 5 in., very much like a thread in a needle. No anesthetic is used. The skin of the edematous area is prepared with antiseptic solution (e.g., tincture merthiolate). An incision is made using a new, sharp, beveled blade in the side of the area and continued through the bag of fluid and out the opposite side, pulling the handle with the rubber dam through the incised wound. The rubber dam then remains as a through-and-through drain. By cupping the dam, the sulfallantoin powder sprinkled in it is carried directly into the wound. The wound is then dressed with sterile gauze, and remains so for several days, depending upon the amount of drainage. When infection subsides or drainage ceases, the upper end of the rubber dam is cut to permit that opening to heal. The lower end remains open for any residual drainage. The remaining portion of the rubber dam is shortened daily and removed when healing is complete. This procedure is often followed in hematomas." An occasional infected bursitis requires an additional wet dressing. (Figs. 10 to 13.)

Skin. Serious skin conditions are promptly referred to a dermatologist. Generally the average wound is often excessively treated by the overly conscientious attendant with a resultant frequency of revisits, increased use of supplies and delayed healing from repeated trauma of dry, adherent dressings pulling wounds open and causing unnecessary discomfort. Occasionally, a dermatitis medicamentosa arises from excessive treatment. Cleansing an injured part is most important. For this we have found magic glove with phenol effective and harmless and capable of removing much detritus when all other methods have failed.

With a large rotating staff and a well stocked variety of medicaments it is important to have a consistent program of medication, which will be followed through for proper and rapid termination of disability. Although well stocked with a large variety of ointments, standard U.S.P. proprietary and combinations thereof, we have found it wise to use ointments as little as possible. We have used tarbonis cream freely in a variety of skin conditions and have found it a valuable addition to our armamentarium.

A few successful variances in therapeutics which have been most helpful were the treatment of abrasions as though they were burns, the abstinence of the use of ointments upon lacerations which healed more rapidly when the greasy film between the severed edges was withheld and the use of the customary anesthetic, astringent pile ointment on certain indolent wounds.

Trichophytosis, especially the athletes foot, responds nicely to about three varieties of medicaments. We have used three types of modified Whitfields ointment for varying stages of trichophytosis. If markedly extensive, eroded, macerated and deeply imbedded, the patient is asked to soak his feet in potassium perman-

ganate 1:5000 on five successive days. This then is followed by nightly applications of an ointment of the following

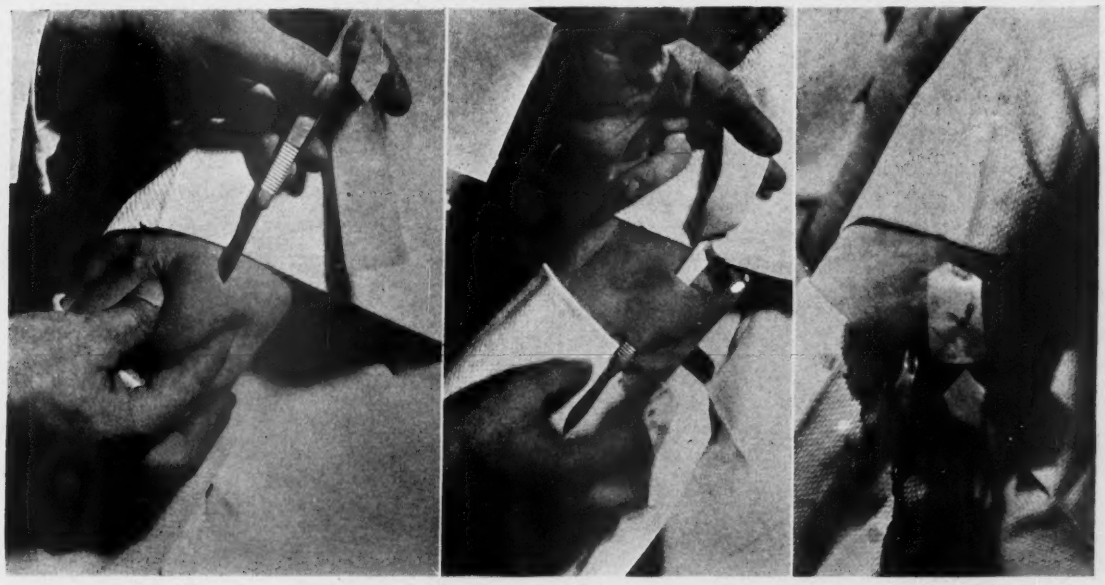

Fig. 11. Fig. 12. Fig. 13.

Fig. 11. Showing position of scalpel before incision is made for bursitis.
Fig. 12. After incision, showing technic of pulling scalpel with rubber dam through bag of fluid.
Fig. 13. Position of rubber dam remaining as a through-and-through drain.

formula, which makes a satisfactory medicament for tender skin especially in the female:

	Per Cent
Thymol	3
Benzoic acid	3
Salicylic acid	3
Lanolin	20
Petrolatum	21
Pontocaine oint	50

As the maceration and erosion improve the quantity of thymol, benzoic and salicylic acid is doubled to 6 per cent each and when practically healed and as a prophylactic the final formula used is:

	Per Cent
Thymol	12
Benzoic acid	12
Salicylic acid	12
Lanolin	32
Petrolatum	32

A valuable adjunct is the nightly sponging of the shoes with a very dilute lysol solution. An important precaution to prevent a burn is the use of the medicament only upon retiring and the use of the proper strength upon sensitive skin especially females and red heads.

Herpes Zoster, simplex and otherwise, have been successfully treated by our Dr. La Re Signor by complete freezing of all vesicles with ethyl chloride every twelve hours. There is relief from pain and burning, rapid drying of vesicles and rapid recovery.

We rely to a large extent upon liquids, solutions and lotions as wet dressings and soaks. Our armamentarium consists of:

Boric acid wet dressings
1% Aluminum subacetate
1% Silver nitrate
1% Resorcin
½% Formaldehyde in alcohol
Alcohol wet dressings
1:5000 Bichloride of mercury

For the cleansing of soiled hands and wounds we resort to tincture of green soap, carbon tetrachloride, peroxide, alcohol, magic glove, etc.

In passing, we wish to comment on the use of the bichloride of mercury wet dressings, which must be used with caution and when so used will prove to be a valuable adjunct for infectious wounds. The dressing can have an initial application of

1 to 5000 bichloride of mercury and be kept moist by further wetting from running tap water until moisture returns to the original. In this way there is no progressive increase in the concentration of bichloride. Its use must be guarded in the aged and those with faulty kidneys and should not exceed forty-eight hours.

Sulfa Drugs. Our experience has been with sulfallantoin powder and ointment sulfanilamide, sulfathiazole and sulfadiazine. For internal use we have found the sulfathiazole and sulfadiazine most desirable because of their lesser reactions than sulfanilamide. We are now using sulfallantoin internally but cannot report its action at this early date. Sulfanilamide is desirable for open wounds because of its ready solubility in the body tissues, but has the disadvantage of more probable secondary dermatitis or, as in two cases, of apparently producing an allergy which was manifested some weeks later when used again upon the same patient. Sulfallantoin has produced practically no dermatitis thus far in our work and we have been quite bold feeling reasonably secure in the use of this product which we have used freely in any variety of locations, and its free use in large quantities in the eye has given no reactions. It has the advantage of hemostasis if such is desired; however, if the surgeon desires free drainage, sulfanilamide becomes the drug of choice. An additional advantage of sulfallantoin is the fact that it provides simultaneous bacteriostatic action and cell-proliferant action while the reason for the easy penetrating ability of the sulfallantoin ointment may be attributed to its cholesterol base. We might add that sulfallantoin proved specific in streptococcic infections but of no value in certain staphylococcic infections. To date, sulfathiazole has proved the drug of choice for internal use, though our experience with sulfallantoin and sulfadiazine is as yet limited. Sulfanilamide is still the most economical.

SUMMARY

An adequate staff and ample space, proportionate to the size of the plant, should be the basis for the proper function of a medical department. However, it is doubly important that its personnel be especially trained for this type of work and constantly on the alert for the development of any new methods which might facilitate the rapid rehabilitation of the injured and sick.

In this report I have tried to enumerate those cases which are commonly found in a large shipyard industry and described the technics we have found most advantageous in our efforts to shorten the time of disability of the injured employee. The various types of medications used have been discussed as well as a few odd cases which appeared in our dispensary. It is our endeavor always to seek improvements and necessary adjustments may have to be made as we go along.

RECONSTRUCTION OF NASAL TIP

A NEW TECHNIC

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RECONSTRUCTION of the nose is one of the earliest operations known to man, having been performed by surgeons in India 2,500 years ago. This, as we know, consists of utilizing skin from the forehead to cover a nasal defect, and marks the beginning of plastic surgery.

Subsequently, in the latter part of the sixteenth century, Gaspare Tagliacozzi, of Bologna, perfected the Italian method of rhinoplasty by using skin from the arm to reconstruct the nose. Since then, particularly during and after the First World War, many additions have been made to our knowledge of this particular branch of surgery. For example, Filatoff, of Russia, developed the tubed pedicle graft which Gillies, of England, popularized, so that today when a plastic surgeon attempts to rebuild a lost nose he can use a tubed pedicle from the forehead, from the arm, from the acromiopectoral region, from the abdomen or even from the thoraco-epigastric area.

Strangely enough, though the repair of the complete loss of a nose is exceedingly difficult and complicated, the reconstruction of the loss of merely the nasal tip taxes the skill and ingenuity of the plastic surgeon just as much. That is readily understood when one realizes that the tip of the nose is the furthest away from the arteries giving circulation to the face.

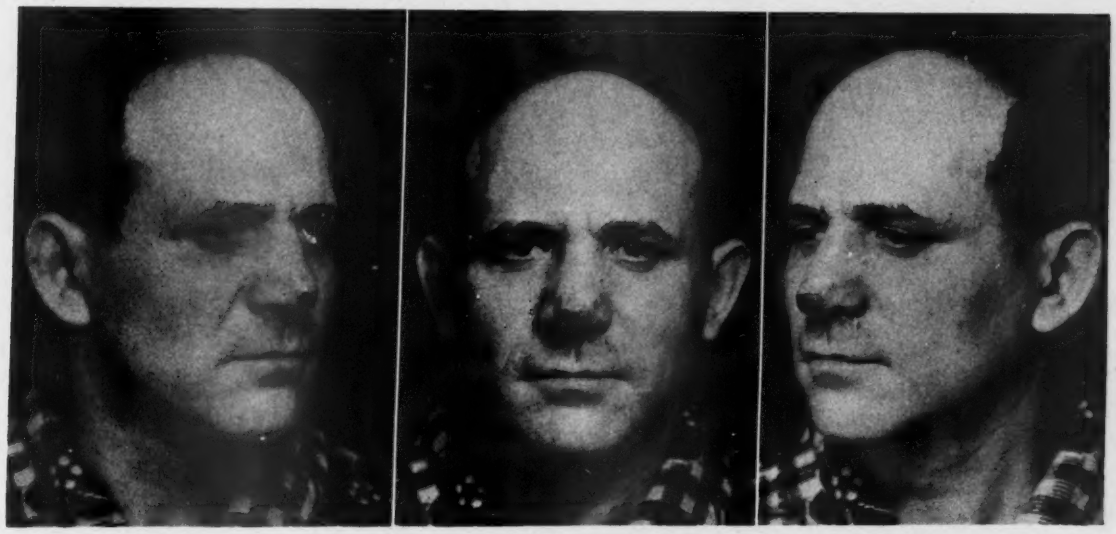


FIG. 1. FIG. 2. FIG. 3.

FIGS. 1, 2 AND 3. Mr. G., aged forty-two, lost the tip of his nose in an accident. The deformity was quite noticeable and the patient sought immediate surgical aid. These illustrations show front and side views of the disfigurement.

Of the various methods used, naturally the forehead flap or the neck flap is the best since the texture and color of the skin from these areas approximate that of the skin of the nose. However, the apparent objection to these technics is that a considerable amount of scarring results from using integument from one visible area of the head and neck to cover another. To eliminate this objectionable factor the author wishes to report a method which he

considers very satisfactory for surgery to cover the loss of tissue of the nasal tip.

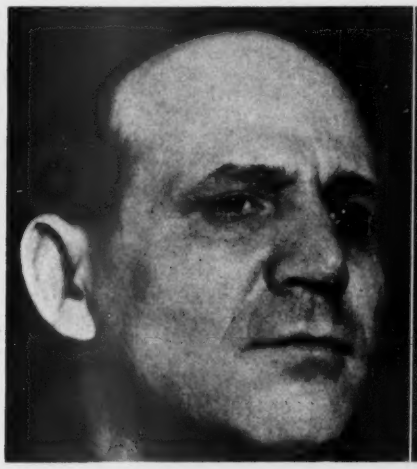
Like the skin of the face the skin of the hands is usually exposed to atmospheric conditions and for that reason the color of the integument of these areas is more or less the same. Therefore, in the method advocated, the skin used lies on the dorsal surface of the hand directly behind the angle formed by the index finger and the thumb. Here there is a certain amount of excess skin that the writer has used for the repair of a nasal tip as the case described below indicates, and because of its location, he has termed the procedure, the "Snuf Box" operation. This technic is simple and can be advantageously incorporated by the military surgeon in his armamentarium to treat wounds of a similar nature received by soldiers on the battlefield.

FIG. 4. Author's method of forming small cylinder with interrupted sutures of fine silk. A fine roll of vaselinized gauze is inserted through the cylinder to give support to the graft.

FIG. 5. Sixteen days later. Tube unrolled, cut from one end of hand and brought to point of repair. Cast prevents motion of graft.

FIG. 6. Close up view showing graft growing into nasal defect.

The skin to be utilized is transformed into a small tube with the raw surface outward, so that in reality it is more like a cylinder of tissue rather than a tube. The purpose of this is that, when unrolled for use on the nasal tip, it has not grown to itself and is, therefore, flat and not bevelled as would occur when unrolling the Filatoff-Gillies tube. When ready, the unrolled cylinder is detached from one end of the hand and brought to the point of repair. Two to three weeks later the graft is liberated from its other attachment to the hand and the surgery of the nasal tip is finally completed.



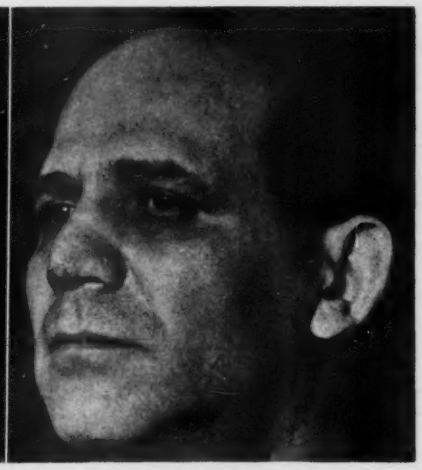


Fig. 7. Fig. 8.

Figs. 7 and 8. Result nine weeks later.

The important thing to remember is that the cylinder of skin must be prepared while the thumb is in abduction, so that the function of the fingers is in no way impaired. Another practical suggestion is to use the left hand in right handed individuals. Naturally the skin contiguous to the wound on the hand resulting from the preparation of the graft is undermined and approximated with interrupted sutures of silk.

Free grafts, like those from the upper eyelid and from behind the ear are of value to cover certain small defects of the face; but in defects of the nasal tip where the circulation is poor, such free transplantation is very risky, and its chances of "taking" cannot be compared with the certainty of a tubed pedicle graft.

It is true that Ivanissevich, of Buenos Aires, and Gillies, of London, have employed the hand as a carrier of a graft from one part of the body to another, but at no time, to the author's knowledge, has the skin of the dorsum of the hand been utilized to repair a defect of a nasal tip.

Fig. 9. Hand with thumb in abduction indicating no loss of function of digit. Scar barely visible for practical purposes.

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PYOGENIC LIVER ABSCESS IN THE AGED

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PYOGENIC liver abscess is diagnosed rarely in the later decades of life and is characterized by a very high mortality. The general pathologic features of pyogenic liver abscess in individuals of advanced age are the same as in younger groups, but in the aged this disease presents certain special clinical considerations.

Ochsner, DeBakey and Murray, in an analysis of 830 cases of pyogenic liver abscess collected from the world literature, with forty-seven additional cases reported from the Charity Hospital and Touro Infirmary of New Orleans, have estimated the chief incidence of this condition to be in the third to fifth decades of life. The reports of Collins, and Rothenberg and Linder also emphasize the importance of pyogenic liver abscess as a disease primarily of middle age. On the other hand, every series of cases of pyogenic liver abscess includes a small percentage of patients past the fifth decade of life, and in these individuals the condition is usually fatal. It is only by early diagnosis and carefully planned surgical treatment that the mortality rate of pyogenic liver abscess in individuals of advanced years can be improved.

Leaving out of consideration all liver abscesses of amebic type, the causes of pyogenic abscess of the liver may be classified under the following headings: (1) Direct spread of infection from a contiguous suppurative process; (2) extension of infection to the liver from a more distant intra-abdominal focus by way of the portal system; (3) traumatic introduction of infectious agents; (4) embolism, infection being brought to the liver from an obvious focus by the general circulation and (5) cryptogenic, primary, or idiopathic infection, in which an antecedent inflammatory lesion cannot be demonstrated. Pyogenic liver abscesses may be single or multiple and are found in the right lobe in the majority of cases. The usual infective agents have been reported to be the staphylococcus, streptococcus, Bacillus coli, Bacillus mucosus capsulatus, or a combination of these organisms. St. John, Pulaski and Ferber found an anaerobic non-hemolytic streptococcus as the causative agent in one infection of primary type. In the aged, pyogenic liver abscess is commonly due to a direct extension of infection from a suppurative process of the extrahepatic biliary system. In acute cholecystitis, associated with cholelithiasis, calculi may penetrate the wall of the gallbladder to cause a solitary abscess of the adjacent hepatic parenchyma. When the spread of infection to the liver is by way of a suppurative cholangitis, multiple liver abscesses are the rule.

The significant findings in a typical case of pyogenic liver abscess are chills, fever of irregular septic type, pain and tenderness in the region of the liver, and hepatic enlargement. Nausea and vomiting are not characteristic symptoms. Jaundice occurs late, usually in the case of multiple abscesses, and is of ominous import. The blood usually shows a marked leukocytosis with an increase in the percentage of polymorphonuclear cells. The characteristic roentgenologic finding is an elevated, immobile diaphragm. Complications are frequently produced by extension of infection from the primary liver focus, particularly when operation is delayed; and the clinical picture is altered under these circumstances according to the direction of the extension and the organs which are secondarily involved. The most common complicating extension is to the chest to

produce an empyema or lung abscess; or the general abdominal cavity may be involved with the production of a peritonitis or subphrenic abscess. Rare complications include rupture into the pericardium, abdominal wall, inferior vena cava, or thoracic duct. A generalized pyemia may occur in any case.

Treatment of pyogenic liver abscess, in general, is surgical, since without operative intervention, the outcome will almost invariably be fatal. When the diagnosis is made, the plan of surgical approach must be determined exactly, since the type of drainage instituted is a factor of great prognostic importance. When the abscess is located anteriorly in the lower portion of the right lobe, the abdominal approach is indicated and the operation is best performed in two stages. When the infection involves the dome of the right lobe, drainage is accomplished by a posterior operation, the abscess being opened by a two-stage transpleural procedure or best by a completely extraserous approach. According to the principle of staged drainage, the serous membranes are packed or sutured at a first operation, and evacuation of the liver abscess is then accomplished with great safety by a second operative procedure. The posterior extraserous approach to an abscess of the dome of the right lobe depends upon the resection of the twelfth rib, with retroperitoneal dissection to expose the liver. In any drainage operation, the great danger lies in the contamination of the virgin pleura or peritoneum; and diagnostic aspiration of an abscess is only justified at the time of actual surgical drainage as a guide to the operator.

The general mortality rate in pyogenic liver abscess treated surgically is high, according to the various series of cases reported. Collins has reported a general mortality rate of 54.5 per cent in patients undergoing surgical drainage. The analyses of Ochsner et al. tend to show that a definite relationship exists between the type of operative procedure employed and the mortality rate. These investigators found a 72.7 per cent mortality in patients drained by the transperitoneal route, a mortality of 66.6 per cent in those drained by a transpleural approach, and a mortality of 33.3 per cent in patients treated by the extraserous operation. Rothenberg and Linder found a general recovery rate of 58.3 per cent in their series of patients with pyogenic liver abscesses treated surgically. Of twelve patients drained by the abdominal route, 41.7 per cent lived; of twelve patients drained by the transpleural technic, 75 per cent lived. The occurrence of complications has been found to increase the mortality rate of pyogenic liver abscess to 90 per cent, while multiple abscesses are fatal in 95 per cent of cases (Ochsner et al.).

In the aged group, the indications for operative treatment are the same as in younger individuals, and age alone must not be considered the determining factor when the advisability of operation is in question. As Cole has observed, old people stand laparotomy surprisingly well, provided no serious degenerative process, such as cardiac decompensation or nephritis, exists as a complication. The operability of an individual of advanced years will depend more upon his general physical condition than his age. Diagnosis in older patients is usually somewhat more difficult than in younger groups because they frequently show fewer signs and symptoms; in the aged, the onset may be more insidious, fever may be of low grade, leukocytosis not so high, and, because of an apparent relative insensitivity to pain, these patients may complain very little. When operation is performed, the peculiar susceptibility of these older individuals to shock, because of concomitant degenerative changes in the cardiorenal and central nervous systems, must be kept in mind. Careful preoperative and postoperative treatment, with a surgical technic of utmost gentleness, and a minimum period of operative time, is requisite to success in the handling of these cases.

The following cases illustrate some important considerations in the management of pyogenic liver abscess in the aged:

CASE REPORTS

Case 1. W. S., male, age seventy-three, a native of southern Germany, was admitted to St. Lukes Hospital, Boise, Idaho (Case No. 14554RA) on October 2, 1940. His presenting complaints were: a productive cough of three weeks' duration following a cold, slight fever, anorexia, and a gradual loss of weight and strength. He had been confined to bed for one week but his cough had not been relieved by ordinary medical treatment. According to his past history, he had always been thin and had had a chronic cough for years. In 1936, he was treated successfully for an acute urinary retention; and a malignancy of the prostate was suspected at that time, but not proved. The positive physical findings at the time of his admission were as follows: General emaciation, weakness, and pallor; mild pyorrhea, with tongue dry and coated; dullness to percussion over the right lung base, with breath sounds distant, and numerous coarse bronchial râles; an almost constant cough, productive of large amounts of mucopurulent sputum; heart normal, blood pressure 110/80; abdomen flat, no masses or tenderness, liver and spleen not palpable; prostate moderately and symmetrically enlarged; temperature ranging between 100° and 101°F. Examination of the blood showed: Red blood cells 4,410,000, hemoglobin 75 per cent, white blood cells 15,350, with 76 per cent polymorphonuclears; urinalysis was negative, aside from a small amount of albumen; the sputum showed pneumococci, streptococci, staphylococci, and Vincent's organisms. Roentgenograms of the chest showed an increase in density of the lower two-thirds of the right lung base. Possible diagnoses considered were: Bronchiectasis, complicated by pneumonitis; lobar pneumonia; lung abscess.

Supportive treatment, including intravenous glucose, blood, plasma, and neoarsphenamine, and parenteral administration of sulfonamides, failed to improve the patient's condition. The development of signs of pleural effusion led to aspiration of the right chest, and the removal of blood tinged fluid which showed a streptococcus on culture; but there was no improvement in the general clinical picture following thoracentesis. The cough continued and the sputum became more purulent and developed an offensive odor. The temperature remained of a septic type. In the blood, leukocytosis was not marked, varying between 6,400 and 12,800.

Repeated roentgen studies of the chest demonstrated a clearing of the dense area in the right lung base noted at the time of admission, but a marked right pleural thickening was then apparent. A circular calcified area about 2½ inches in diameter, in the upper portion of the right lobe of the liver, was noted in all chest films, but this was considered to have no relation to the chest findings. On November 4, 1940, an entirely new light was thrown on the case, however, when un upright anteroposterior roentgenogram showed a fluid level in this calcified area. An upright lateral roentgenogram (Fig. 1) demonstrated conclusively a fluid-containing cavity in the mid portion of the dome of the liver. In view of this finding, a diagnosis of liver abscess with perforation into the base of the right lung was made.

Drainage of the liver abscess was carried out on November 5, 1940, using local and gas anesthesia. A segment of the tenth rib, 3 inches long, was resected in the posterior axillary line, and the abscess located without difficulty by aspiration through the adherent pleura and diaphragm. A large rubber tube was then inserted, and the thoracic wound packed open with gauze. The opening of the abscess was followed by a profuse drainage of foul yellow pus, which showed on smear the same mixed infection previously found in the sputum, and, in addition, many typical echinococcic hooklets. The roentgenological report of the findings in an upright portable film (Fig. 2) on the day following operation is as follows: "Further AP film of the chest shows some clearing of the right base. The abscess cavity in the liver is filled with air, and a drain tube leads to this cavity. There is no air seen in the right pleural sac."

Although the patient was given very active supportive treatment, he failed steadily after operation, developing a terminal paralytic ileus. He expired on November 7, 1940. The autopsy findings, as reported by the pathologist, were as follows: "The body is that of a small, poorly nourished white male, age about 70 years. The abdomen is tense. There is a rubber tube drain in the right side extending into the liver. Upon opening the abdomen, the intestines balloon

out. The thin omentum has enlarged vessels. There is some pus between the loops on the right side. The liver is 5 cm. below the costal margin. The liver is adherent at the dome to the diaphragm. There is some pus around this area. The prostate is enlarged. The kidneys are slightly fibrous. There are no other gross abnormalities in the abdomen with the exception of a rubber tube extending into the liver at the point of adhesions to the diaphragm. The right lung is adherent to the pleura at the sides and posteriorly. The lower lobe is solid and dark red, and is adherent to the diaphragm. An abscess, $4 \times 2\frac{1}{2} \times 2$ cm., is found in the lower lobe; this is continuous through the diaphragm with an abscess in the liver. There is a wall of calcium, about 4 cm. thick, about a cavity $4 \times 3 \times 3$ cm. A new abscess has burrowed about this wall. The left lung has some fresh adhesions between the lower and middle lobes, and at the apex. The chest cavity contains about 20 cc. of free fluid. There is 15 cc. of amber fluid in the pericardial sac. The heart muscle is brown and soft. The coronary vessels are slightly beaded. The prostate is enlarged, and fibrous. Anatomical findings: Abscess of lung, right lower lobe, extending through diaphragm into liver; terminal pneumonia, right lower lobe; old walled abscess of liver, with new abscess about it; acute local peritonitis; hypertrophy of prostate."

Fig. 1. Case 1. Preoperative lateral roentgenogram shows fluid level in abscess cavity of the right lobe of the liver.

DISCUSSION

This case presents some unusual clinical features and the exact order and relationship of the pathologic events is not clear. The infection may have been primary in the lung, extending by contiguity, or embolism, to produce an abscess at the site of an old calcified echinococcic cyst in the right lobe of the liver. An opposite interpretation is also possible, however, and the infection may have been of cryptogenic nature, originating in the liver in relation to the calcified cyst and extending into the thoracic cavity to involve progressively the diaphragm, pleura, lung parenchyma, and bronchi. The immediate cause of death

may have been the operative spread of infection to the peritoneal cavity, but this patient's age, associated physical infirmities and prolonged illness weighted the balance heavily against him. An earlier diagnosis, increasing his chances of survival, might have been made, if the possibility of the existence of a liver abscess had been considered earlier. A completely extraserous operative approach would have rendered infection of the peritoneum less likely and might have resulted in a favorable outcome in this case. The heavy calcified wall of the echinococcic cyst, as uncovered at autopsy, would probably have proved a very serious, if not insuperable, obstacle to the healing process under the best of circumstances, however.

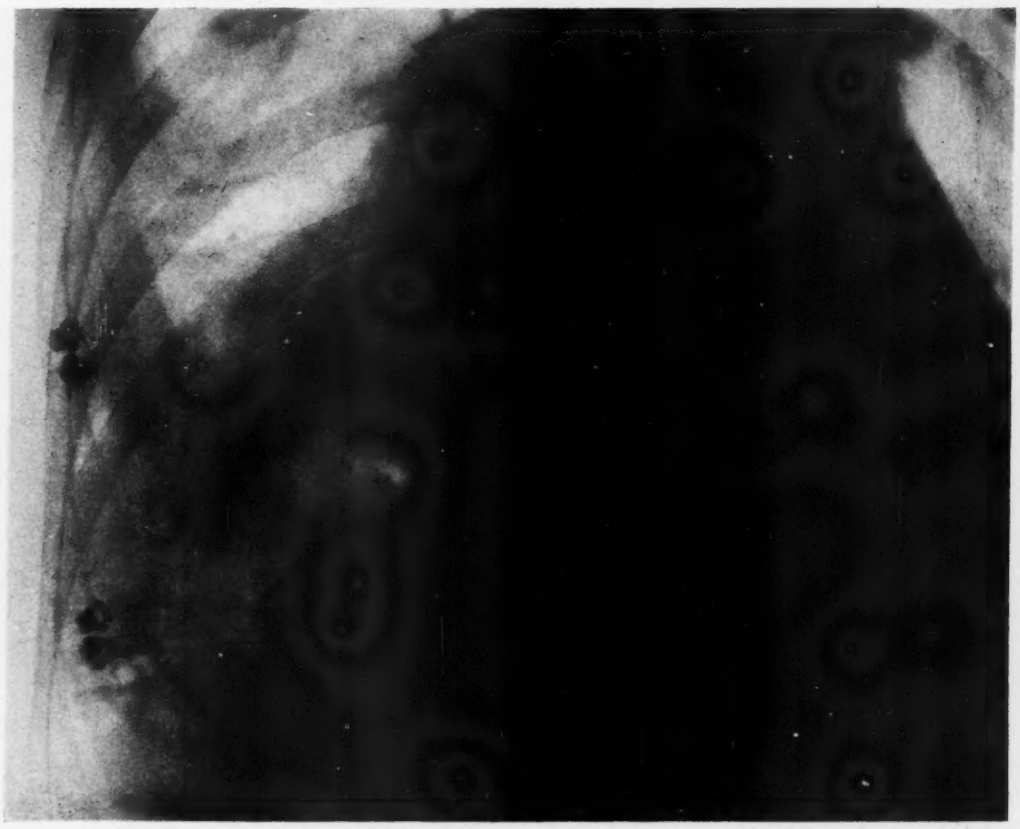

FIG. 2. Case 1. Postoperative anteroposterior roentgenogram shows air in liver abscess cavity. Drainage tube leads to calcified wall of echinococcic cyst.

CASE II. L. S., female, age seventy-five, a native of Sweden, was admitted to St. Alphonsus Hospital, Boise, Idaho, (Case No. 31122) on March 4, 1941, in an attack of acute abdominal pain of forty-eight hours' duration. The attack began after the patient had eaten a large amount of popcorn. She had been nauseated, vomited repeatedly, and no relief was obtained by treatment at home. Two facts were considered to be of importance in her past history: Her family stated that she had had a cholecystectomy nineteen years previously, and she was known to have had a large fibroid uterus for many years. In general, she had enjoyed good health for years with no symptoms referable to the biliary tract.

On admission to the hospital, this patient appeared as an acutely ill, well preserved female of seventy-five years. The physical findings may be summarized as follows: Face flushed; nose and throat negative; chest clear; heart normal except for a slight tachycardia, blood pressure 165/100; abdomen showed an upper right rectus scar, a slightly tender mass in the right upper quadrant which was interpreted as a Riedel's lobe of the liver, and marked tenderness and muscle guard in the right lower quadrant; in the pelvis a fibroid uterus the size of a large grapefruit was found, the other pelvic organs being atrophic. The temperature was

100°F. The white blood cell count was 22,000, with 90 per cent neutrophiles. The urine was essentially negative.

beneath the recently healed laparotomy scar, in the right side of the abdomen. Incision into this obvious mass was made, under local anesthesia,

FIG. 3. Case II. Roentgenogram before drainage of liver abscess, shows elevation of right leaf of diaphragm.

The clinical picture suggested an acute surgical abdominal condition, either an intestinal obstruction or an acute inflammatory process in the right lower abdominal quadrant. An emergency laparotomy was carried out on March 4, 1941, using a lower right rectus incision. An appendectomy was performed and constricting adhesions in the region of the ileocecal valve were removed. Other dense adhesions in the region of the right lobe of the liver were found at operation. Aside from a large fibroid uterus, however, nothing else abnormal was found in the abdomen. After operation the wound healed well, but there was a persistent moderate daily elevation of temperature. A roentgenogram of the chest on March 13, 1941 (Fig. 5) showed the lung fields to be clear, with a moderate elevation of the right leaf of the diaphragm. In the fourth postoperative week, after several bouts of unexplained high fever, a bulging became apparent on April 9, 1941, and a profuse discharge of pus and bile was obtained. A culture taken from this purulent discharge showed a staphylococcus. Following insertion of a soft rubber tube, ½ cm. in diameter, small dark calculi appeared in the drainage, and during the next week about thirty of these appeared on the dressings. The appearance of these biliary calculi in the drainage demanded a reinvestigation of the past history of a cholecystectomy, and a search was instituted for the record of the patient's gallbladder operation nineteen years previously. The patient's old record (from 1922) was located and found to include an operative note indicating that a cholecystotomy, with the removal of calculi and complete excision of the mucous membranes of the gallbladder had been performed at the time of the original operation instead of a true cholecystectomy.

The patient developed a deep abscess of the left thigh within a week of the opening of the

abdominal abscess, necessitating incision and drainage on April 14, 1941. From this questionably metastatic lesion, a staphylococcus was cultured.

One week after the patient's return home, the drainage tube was removed and the remaining sinus quickly closed. She was quite well during the next three months, and recovered

FIG. 4. Case 11. Roentgenogram shows abscess cavity of right lobe of the liver filled with lipiodol. Drainage tube is in place.

Roentgenograms taken after the injection of lipoidol into the drainage tube on April 29, 1941, showed a large abscess cavity in the lower portion of the right hepatic lobe (Fig. 4), and no connection with any portion of the extrahepatic biliary system could be demonstrated. A large rubber tube, 2½ cm. in diameter, was inserted on May 1, 1941. Thereafter, the drainage rapidly diminished, and roentgenograms taken on May 9, 1941, indicated marked diminution in the size of the abscess cavity. The patient was discharged on May 17, 1941, after approximately ten weeks in the hospital. It is of interest to note that during this period of treatment for a severe pyogenic infection, her white blood cell count ranged most of the time between 11,000 and 16,000. Her mental faculties failed considerably under the strain of her illness and she was completely irrational a great deal of the time.

almost entirely her old mental equilibrium. On August 17, 1941, however, she was sent to St. Luke's Hospital, Boise, Idaho, (Case No. 68473) for emergency operation, when she developed a painful mass in the right subcostal region, associated with fever and a moderate leukocytosis. Using local anesthesia, incision was made directly over this mass to open widely a large thick-walled abscess cavity. This abscess involved the right lobe of the liver and the overlying abdominal wall, and was connected at one point with a shrunken fibrous tube, which was lined with granulation tissue and undoubtedly represented the remains of the gallbladder. The abscess cavity contained bile-tinged pus and about twenty biliary calculi of various sizes. Using forceps and scoop, all calculi were removed, and the cavity flushed out thoroughly with saline. A large rubber tube drain was then inserted and the wound closed

loosely, using through-and-through silkworm gut sutures. The patient had a convalescence following operation which was stormy at times, due to the instability of her central nervous system. Her highest post-operative temperature was 102°F. on August 25, 1941, the first day she was tried out of bed. Thereafter her temperature subsided, and she continued to be up, leaving the hospital on September 20, 1941, with a small drainage tube in place. Post-operatively, repeated roentgen studies following lipiodol injection showed a progressive diminution in the size of the abscess cavity. At no time was a connection between the abscess cavity and the common bile duct demonstrated and no biliary calculi were apparent in the films.

This patient's drainage tube was removed shortly after her return home, and her sinus promptly closed. She quickly recovered physical and mental vigor. At the present time, after almost two years, her family physician reports that she is enjoying good general health and has no abdominal symptoms.

DISCUSSION

This case represents a statistically much more common type of pyogenic liver abscess than Case 1. The pathogenesis of the infection is clear, since in this patient the presence of calculi in the abscess cavity indicates a rupture of the infected gallbladder into the hepatic substance. The operations by which drainage was accomplished in this case constitute an undeliberate, but successful, staged surgical procedure. In this aged hypertensive individual, showing evidence of definite cerebral degeneration, a primary drainage of the pyogenic liver abscess might have resulted in a quick fatality.

SUMMARY

1. Pyogenic liver abscess occurs rarely in the aged and is characterized by a high mortality.

2. The pathogenesis of pyogenic liver abscess in individuals of advanced years is similar to that of hepatic infection in younger groups of patients. In the aged, however, the diagnosis is frequently rendered more difficult by the fact that these older patients react minimally to the disease process. In individuals past the fifth decade, the onset of the infection may be insidious, and the classical signs and symptoms of pyogenic liver abscess may be diminished or absent.

3. In the aged, the indications for operative treatment of pyogenic liver abscess are the same as in younger individuals, and age alone must not be considered the determining factor when the advisability of operation is in question. The type of drainage operation performed, whether transperitoneal, transpleural, or extraserous, is determined by the situation of the lesion, as in younger patients. The peculiar susceptibility of older individuals to surgical shock, because of the likelihood of concomitant degenerative changes of a cardiorenal or nervous nature, should be kept in mind, however. Success in the handling of pyogenic liver abscess in the aged will only be attained by early diagnosis and careful preoperative and post-operative treatment. In these cases, a surgical technic of utmost gentleness should be employed, and all operative procedures should be carried out in the shortest period of time practicable.

4. Two cases of pyogenic liver abscess in individuals of the seventh decade of life are presented. In one case a fatal infection was associated with a calcified echinococcic cyst of the dome of the liver. In the other, recovery followed abdominal drainage of an abscess caused by the rupture of an infected gallbladder into the liver parenchyma.

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RIGHT INGUINAL HERNIA FOLLOWING LOWER ABDOMINAL INCISIONS*

A REPORT OF THIRTY-ONE CASES

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SURGEONS have long been aware of the fact that right inguinal hernia may follow a right McBurney incision. In a recent comprehensive book on the subject of hernia Iason stated that right inguinal hernias "occasionally" follow a right McBurney incision. In the repair of 293 right inguinal hernias at the Station Hospital, Fort Bragg, North Carolina, a much larger group of cases than has been reported previously was encountered. Our experience has suggested to us that a defect in the transversalis fascia is the causative factor.

LITERATURE

A few cases of right inguinal hernia following a McBurney incision have been reported in the literature from time to time. The main cause for the occurrence of the condition has been ascribed variously to (1) increased intra-abdominal pressure, (2) omental adhesions to the peritoneum at the internal ring, and (3) diminished resistance of the walls of the inguinal canal secondary to injury of the iliohypogastric and ilio-inguinal nerves.

Oudard and Jean reported eight cases of right inguinal hernia following appendectomy, in the repair of which a constant finding was diffuse omental adhesions in the hernial sac. Giordani reported four additional similar cases; at the repair of these hernias omental adhesions were not found, but weak and atonic internal oblique and transversus muscles were present in addition to the hernial sac. He ascribed this finding to stretching or section of the iliohypogastric and ilio-inguinal nerves at the time of appendectomy. Previously Moschowitz and Neuhof had published some research work which demonstrated that section of these nerves resulted only in a temporary anesthesia in the hypogastric region and not paralysis of any muscle. Andrews corroborated this conclusion when he found that all motor fibers of these nerves are given off before they enter the surgical field. On the other hand, Watson in a recent review of the causes for the development of inguinal and femoral hernias stated that "any variety of hernia may develop after any abdominal operation." He did not state why he believed this, but inferred that the cause is increased intra-abdominal tension.

It has been only in the past few years that the rôle played by the transversalis fascia in the cause and cure of inguinal hernia has been stressed. Ferguson in his original communication suspected this when he stated that faulty development of the internal oblique and transversalis muscles weakens the internal ring and is the most common cause of indirect inguinal hernia. Cupei stated that the "elastic" function of the transversalis fascia was its most important property in the prevention of inguinal hernia. Jennings, Anson, and Wright have been so impressed by the importance of the transversalis fascia that they have proposed a repair through a midline incision. They have claimed that the only procedure necessary for a cure is to close the transversalis fascia over the stump of the hernial sac which has been ligated extraperitoneally. Zieman has stated the proposition succinctly by saying that "an anatomically perfect transversalis fascia comprising the internal inguinal ring is inconsistent with hernia of the cord."

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MATERIAL

In the period from April, 1941, to November, 1942, right inguinal hernia was found on thirty-five patients who had undergone a previous appendectomy through an incision in the right lower quadrant. For the purpose of this study four of these cases were excluded, one because a nineteen-year interval had elapsed between the appendectomy and the appearance of the hernia; one because a left inguinal hernia had been repaired prior to appendectomy, thus indicating the probable existence of bilateral congenital hernias; and two because operation was refused.

Of the thirty-one remaining patients the right inguinal hernia in three patients followed a scar in the right lower quadrant, type unrecorded; the hernia in nine patients followed a low right rectus incision; the hernia in nineteen patients followed a right McBurney incision. These cases comprise 12 per cent of the total number of right inguinal hernias repaired in the same period.

In the group of thirty-one hernias three were recurrent, right, indirect, inguinal hernias following incisions in the right lower quadrant, and are of particular interest. The first patient developed an indirect recurrent sac, the repair of which held firmly after concurrent repair of a hernia through a previous right McBurney incision. The second patient had had a primary repair of a right inguinal hernia as a child; following a low right rectus incision for an appendectomy, the inguinal hernia recurred. In the third patient an apparently satisfactory primary repair had broken down to form an indirect recurrent sac following a right McBurney incision for an appendectomy.

The time interval between the incision in the right lower quadrant of the abdomen and the appearance of symptoms suggesting an inguinal hernia was calculated. In the three cases with an unknown type of incision in the right lower quadrant the average time was 4.7 years. In the nine patients with a low right rectus incisional scar the interval was six years. In the nineteen cases with a right McBurney scar the time interval was 5.8 years. In short, it took approximately five years of the stress and strain of ordinary living to push the peritoneal pouch through the internal abdominal ring sufficiently to cause symptoms. It is stressed that all but four of the thirty-one hernias were the indirect type.

COMMENT

It seems significant that so many cases of right inguinal hernia following an incision in the right lower quadrant have been found. The additional finding of other cases in which a recurrence of a right inguinal hernia has followed an incision in the right lower quadrant only strengthens the conviction that there is a definite relationship.

In Figure 1 an attempt is made to illustrate the possible anatomical reasons. The transversalis fascia which completely invests the abdominal cavity is found between the transversus muscle and preperitoneal fat as a definite layer. It is particularly clear cut when making a McBurney incision. Following it down it is found strengthening the edges of the internal abdominal ring. Any weakening of this structure will allow protrusion of the peritoneum through the opening. If we now postulate the non-closure of the transversalis fascia or its non-healing following a McBurney incision, it is clear that the internal abdominal ring is weakened if not split apart.

The technical reason for this can be demonstrated clearly. These fibers of the transversalis fascia course obliquely in the same direction as the transversus muscle. When they are split, the edges tend to retract widely. This has been proved many times by putting traction sutures through the edges of the transversalis fascia when making a McBurney incision. At the time of closure these same edges often are found

deeply retracted under the transversus muscle, where they could be missed easily by the closing suture. It is for this reason that the practice of closing a McBurney incision with one or two sutures, or even none at all, in the internal oblique and transversus muscle layers is decried. There is little doubt, however, that many McBurney incisions closed haphazardly will heal solidly and give no further trouble. On the other hand, when in this series it is shown that one-sixth of all right inguinal hernias follow incisions in the right lower quadrant of the abdomen, the failure to take every precaution to insure a lasting result is not to be condoned.

Additional evidence to support the theory that inguinal hernias follow injury to the transversalis fascia in low abdominal incisions was found at operation for these hernias. It may be argued that these hernias may be the congenital type and would have appeared sooner or later in any event.

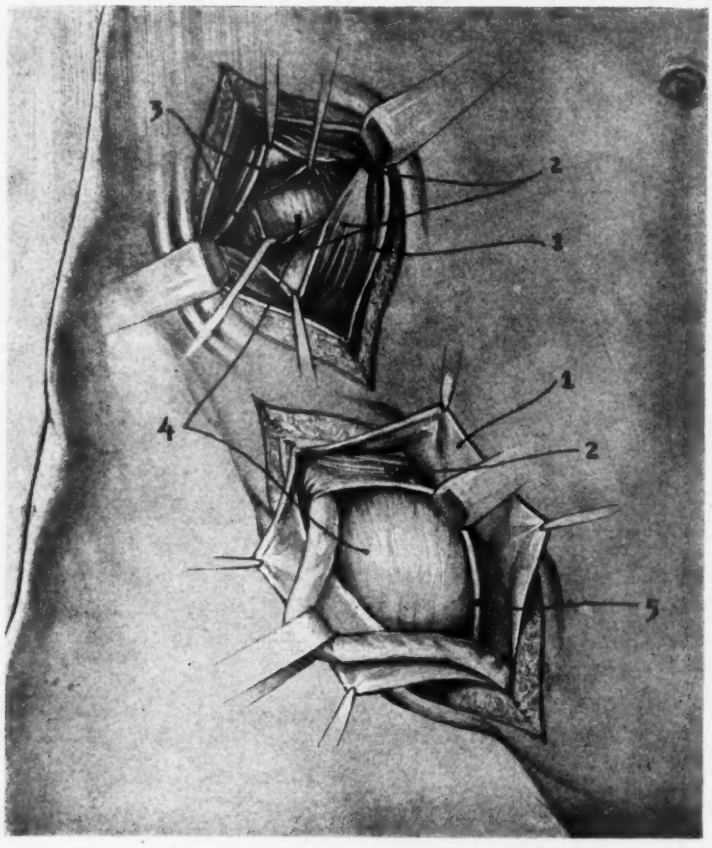

FIG. 1. This illustration depicts the anatomic continuity of the transversalis fascia between a right McBurney incision and a right inguinal incision. 1, Obliquus externus; 2, obliquus internus; 3, transversus abdominis; 4, fascia transversalis; 5, conjoined tendon.

The absence of scar tissue rings in most of these hernial sacs, indicating the lack of the attempt at normal closure of the processus vaginalis, suggests a hernial sac of non-congenital origin. Furthermore, when the McBurney incision was felt from the inside of the abdomen, a weakness could be felt in many cases. In all cases the transversalis fascia was found stretched abnormally around the internal ring.

While it has been shown that in this series 12 per cent of a number of routine hernias have followed incisions in the lower abdomen, there was no adequate way to check the number of patients with incisions in the right lower quadrant who developed right inguinal hernias subsequently.

SUMMARY

1. Thirty-one cases of right inguinal hernia following incisions in the lower right abdomen are reported.

2. These cases represent 12 per cent of the total number of right inguinal herniorrhaphies performed in the same period.

3. Additional evidence is presented to support the theory that the non-closure or non-healing of the transversalis fascia following low abdominal incisions is the main reason for the subsequent appearance of the inguinal hernia.

4. More accurate closure of McBurney incisions with special attention to the transversalis fascia is urged.

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THE RÔLE OF ASEPTIC BONE NECROSIS IN HIP LESIONS*

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THE arrangement of vessels supplying blood to the femoral head is unique. It is, therefore, in the hip joint more than anywhere else in the skeleton, that the sequelae of impaired blood supply can so readily be observed. Indeed, what is commonly known about aseptic necrosis of bone, is largely due to studies of the pathological status of the femoral head.

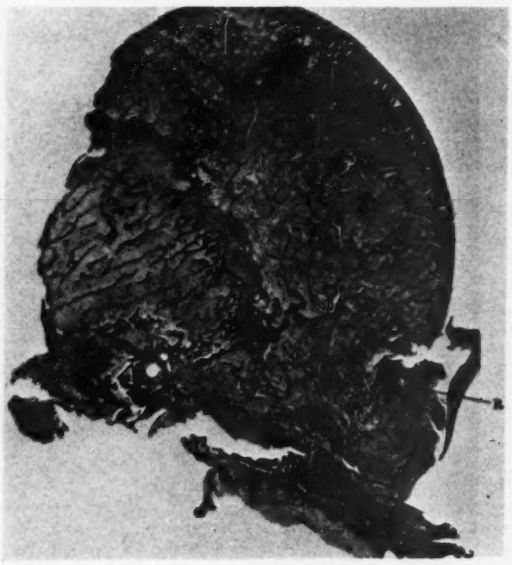

FIG. 1. Healed fracture of the femoral neck in adolescent; proximal fragment in state of total necrosis; R indicates starting fibrous invasion.

Among the various causes of impaired blood flow to the upper end of the femur, those of traumatic origin are seldom the object of controversy since they are best understood.

Fractures of the Femoral Neck. Of prime significance among the traumatic hip lesions is the intracapsular fracture of the neck. The arteries, running through the inner lining of the capsule and entering the neck at the capsular attachment are thus eliminated, leaving intact only the small vessel of the ligamentum teres. Except in early life, this vessel is unable to provide for a sufficient collateral circulation to the head fragment. Generally, it supplies but a very limited area of the head, that is the zone around the "fovea," seat of the attachment of the ligament. With increasing age the ligamentum teres grows thinner and thinner, and at a period of life at which the majority of hip fractures occur, it may have altogether disappeared.

The fractured head, thus largely or entirely deprived of nutrition, undergoes aseptic necrosis and behaves more or less like a free bone transplant. This, however, does not necessarily mean that far reaching or permanent damage ensues. While it is true that necrotic bone takes no active part in the process of consolidation, the adjacent living bone of the distal fragment can unite with the head before this has gone through all the stages of reorganization. This fact has been established beyond doubt on the strength of microscopic sections. (Fig. 1.) It is also known from experimental, clinical and radiological observations, in which bone transplants become firmly incorporated at a time when the revitalizing process throughout the transplant cannot possibly be finished or even be well under way.

Therefore, the importance of more or less extensive necrosis of the head should not be overestimated as far as bony consolidation is concerned. In this connection it is illuminating to compare former statistics on hip fractures with those of recent years. In the pre-Whitman era bony union was indeed an exception. Figures as low as 6 per cent were then reported, most of these fortunate results probably being due to impaction. It is Whitman's merit to have recognized the importance of an exact reduction and to have worked out a

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method of achieving reduction and of securing its maintenance. By this method bony consolidation could be secured in about half the cases. By the introduction of internal splintage, be it nail, screw or bone peg, these figures could further be improved upon, so that at present cases of bony union average about 75 per cent and reach over 90 per cent in the hands of some.

The incidence of necrosis of the head has, of course, been the same before and after Whitman. Beside the lack of blood supply there seem to be other reasons for the precarious outcome in intracapsular hip fractures. The other main difficulty lies with the sources of new bone formation. The most important medium for callus formation is the periosteum and this is

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 2. Healed fracture six months after Whitman procedure; valgus position.
Fig. 3. Same as Figure 2 two years later; late collapse.
Fig. 4. Bony union after Whitman procedure; slight valgus position.
Fig. 5. Same as Figure 4 two years later. Extensive residual necrosis, collapsed and walled off.

absent within the joint, at least its main layer, the "cambium." The central fragment cannot actively participate in producing callus. That leaves the endosteum of the distal fragment as the only source from which new bone is laid down. Endosteal callus is inferior to the periosteal in amount if not in quality. In no event does the distal fragment produce sufficient new bone to bridge a major gap between the fragments, hence the outstanding importance of proper alignment and dependable retention. With these premises fulfilled, the chances for bony union are good, no matter how extensive the necrosis of the head may be. On the other hand, when reduction is unsatisfactory, the prospects of bony consolidation are poor no matter how much alive the head may be.

FIG. 6. Collapse of the head three years after nailing; slight valgus position.

Our failures, therefore, cannot simply be dismissed with the remark "no blood supply." Usually reduction has been insufficient from the beginning or it has not been maintained for some reason or other.

The true significance of aseptic necrosis of the head comes to light *after* healing of the fracture. In a comparatively small number of cases, for which no exact figures can be given, but which may be estimated ranging from 10 to 20 per cent, there develops a pathological fracture, a depression of that part of the head which is mainly subjected to weight bearing. This "late damage" usually occurs one to two years after consolidation of the fracture, while its groundwork has been laid at the moment of the injury. The collapse of this wedge-shaped sector of the upper quadrant may be followed by its separation from the rest of the head, a process not unlike the detachment of a joint mouse in osteochondritis dissecans. The fact that this collapse occurs at a time when all necrotic bone should long ago have been replaced led Phemister to assume that the process of repair may stop before its completion. It may well be that such areas of arrested repair occur much oftener than they become evident through their collapse. It appears that healing in valgus position of the head favors the infraction of these residual necroses. For it is in these cases that the head protrudes laterally and out of the acetabulum, leaving only a narrow sector for carrying the body weight.

This late collapse may occur after any of the approved methods of treatment. It has been observed following the Whitman procedure; it may be seen after insertion of a Smith-Petersen nail as well as after use of an autogenous bone transplant. (Figs. 2 to 8.)

In all these cases bony union of the fracture preceded the ultimate collapse of the head. Only then do the mechanics of weight bearing come fully into play.

Nothing, it seems, can be done to prevent the ultimate break down of an area of defective repair, nor can its occurrence be predicted. Equally undecided remains the question whether one method of treatment is more likely to entail ultimate collapse than the other. As is the case with internal splintage in general, the superiority of an autogenous bone graft over nail or screw is more a matter of personal belief than of proved evidence. For the object of immediate fixation the metallic device is

as efficient as the bone peg. Whether the latter carries an additional biological effect is difficult to say. Greater statistical material and more specimens will have to be studied. Such specimens, on the other hand, are rarely obtained. It seems, therefore, justified to collect and report on these scanty pieces of evidence.

Figure 9 is an *x*-ray of a fractured femoral neck, fourteen weeks after insertion of a bone peg. The specimen originates from a sixty-three year old man who was operated upon nine days after the injury (open reduction, bone peg, plaster spica). He died three and one-half months later from pneumonia. The *x*-ray shows the

Fig. 7. Healed fracture after bone pegging.

Fig. 8. Eighteen months later collapse and demarcation of residual necrosis.

Fig. 9. *X*-ray of a specimen fourteen weeks after bone pegging.

Fig. 10. Cut through same specimen as in Figure 9.

transplant in good position, the fracture line still clearly visible and the fragments only in fair alignment. On a cut through

Fig. 11. Recent epiphyseal separation.

the specimen in the frontal plane (Fig. 10) it is noticed with the naked eye that the peg, as it runs through the distal fragment, is firmly incorporated. In contrast, that part of the transplant which is placed in the head fragment appears loose. In fact, the head could be moved against both the peg and the shaft, the fragments being in fibrous union. Microscopically, the head is largely necrotic as is also the transplant. Only its surface, as far as it is surrounded by the living shaft, shows signs of reorganization in accordance with its gross appearance. Nowhere are traces of new blood vessels to creep along the peg into the proximal fragment. This lack of revascularization is worth mentioning because the growing of new capillaries along the transplant into the head is said to be facilitated by this sort of fixation.

On the other hand, one must bear in mind that the process of bony repair in this particular arrangement differs from the ordinary. Here we have the necrotic head, consisting of cancellous bone, and then, there is the dead transplant made up of massive cortex bone. Cortex, as is known from experiences, needs by far more time for being transformed into living bone than does spongiosa. Thus consolidation of the fracture and reorganization of the necrotic head may be finished at a time at which the cortex transplant is still in the process of repair. That bony union failed to occur in this case does not reflect upon the method of internal splintage; it simply serves to demonstrate that in the absence of a good reduction even the use of a transplant cannot assure consolidation. As far as clinical experience goes, one fact alone speaks clearly for the biological value of the bone graft: In old neck fractures with non-union the transplant may eventually bring about consolidation, while the purely mechanical devices usually fail.

To sum up the significance of bone necrosis in fractures of the femoral neck, it may be said that due to the inactivity of the central fragment, the knitting is retarded. The late collapse of an area of residual necrosis is not a frequent complication. It is, however, equivalent to a failure despite the healing of the fracture, and it requires some sort of reconstruction.

Epiphyseal Separation. What applies to fractures of the neck, holds good not without qualification for epiphyseal separation. If the slipping takes place gradually, there seem to be ways of circulatory adjustment to the changed anatomical situation. But even in sudden, purely traumatic epiphyseal separation the vessels of the teres ligament alone may, at this age, provide for a sufficient collateral circulation. This is known from clinical experience and from experimental studies as well. Personal experiments, carried out some eighteen years ago and aimed at producing traumatic separation of the upper femoral epiphysis, showed that not only the articular cartliage but also the bony part may survive. The cartilage is of course kept alive by the synovial fluid, but bone and medulla tissue depend entirely on blood supply. In some instances the epiphyseal bone did not survive.

It is by no means simple to obtain an epiphyseal separation in experiment. A great deal of force and some luck is re-

quired. Oftener than not, the femur would break rather than give at the desired level. Naturally, the violent manipulation may damage the vessels of the round band. This in turn may account for the difference in outcome regarding necrosis or survival of the bony elements.

Exactly the same observations as in experiments may be made clinically. Some epiphyseal separations heal without radiological signs of necrosis. Others may run through all stages of bone necrosis and repair. Krida and I demonstrated an impressive example of this kind: In a complete epiphyseal separation all roentgenological characteristics of necrosis were present; until about six months after reduction and nailing the structural changes seemed to indicate repair and bony substitution. But another six months later, the entire epiphysis, although healed in perfect position, collapsed. (Figs. 11 to 14.) While in the case just demonstrated the epiphysis broke down *in toto*, one may also find, like in fractures of the neck, a wedge-shaped area of residual necrosis years after reduction and consolidation. Such a development is shown in Figures 15 to 17. Figure 15 is an epiphyseolysis in a twelve year old girl. The result of reduction with subsequent fixation for three months is shown in Figure 16. Three years later the wedge area appeared, surrounded by a zone of condensed bone. (Fig. 17). Situ-

Fig. 12. Fig. 13. Fig. 14.

Fig. 12. Reduction by traction of three weeks' duration, then nailed. Note the contrast in density.
Fig. 13. Six months later structure comes back to normal.
Fig. 14. Another six months later collapse of the epiphysis.

Fig. 15. Fig. 16. Fig. 17.

Fig. 15. Slipped epiphysis.
Fig. 16. Three months after reduction.
Fig. 17. Three years later; wedge-shaped area of residual necrosis.

ated at a sector not subjected to full weight bearing, it escaped pathological fracture.

Figure 18 shows such a wedge-shaped

Fig. 18. A fully detached aseptic "sequestrum."

piece of necrotic bone in the state of complete detachment. In this case, that of an eighteen year old girl, the exact nature of the preceding hip disease remained undecided; the history suggested slipped epiphysis or Perthes' disease. There was a striking contrast between the mild clinical symptoms and the *x*-ray appearance.

may again be jeopardized by forceful manipulation. This holds true also for open exposure of the hip.

Fig. 19. Wedge-shaped residual necrosis ten years after traumatic dislocation.

Traumatic Dislocation of the Hip. While ever so much emphasis has been laid on the precarious blood supply in fractures of the neck, only in recent years has it been realized that a similar predicament may arise from traumatic dislocation; and yet, it is obvious that wide tearing of the

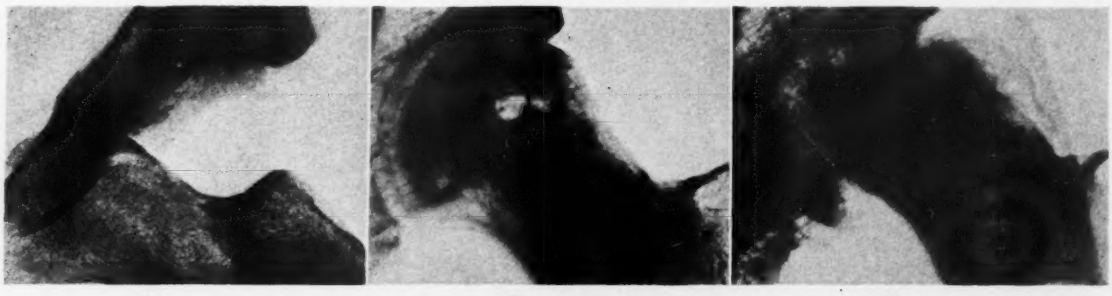

Fig. 20. Fig. 21. Fig. 22.

Fig. 20. Dislocated hip.
Fig. 21. Same as Figure 20 two years after reduction.
Fig. 22. Same as Figure 21 another six months later.

By and large it may be said that aseptic necrosis plays but a minor rôle in epiphyseolysis. One fact stands out and is pretty generally appreciated: In attempting to reduce the displaced parts, no brusque maneuver should be applied. Its use is likely to do more harm than good; for what is left in the way of blood supply or has been reestablished through adaptation, capsule necessarily blocks part or all of the vessels running in the inner lining of the hip joint. In addition, the teres ligament is here also torn, thus eliminating this source of blood supply, too. In the young adult, the preferred age group for traumatic dislocation, more store can be set by this vessel than in old age fractures of the neck.

In 1931, I reported on late changes of the femoral head following traumatic dislocation. As in the previous conditions, its necessary section of the capsule, the following dislocation and reshaping of the head, conditions obtain quite similar to

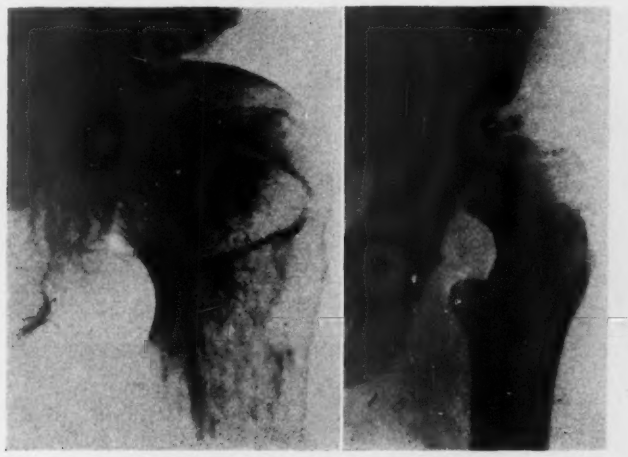

Fig. 23. Fig. 24.

Fig. 23. Congenital dislocation, reduced in early infancy. Note the structural changes at weight bearing sector.
Fig. 24. Fully detached joint body in congenital dislocation.

here again we meet with wedge-shaped areas of necrosis which may collapse under the stress of weight bearing. Stewart, in 1933, was the first in America to report on similar observations. Since then increased attention has been devoted to the consequences of traumatic dislocation (Phemister, Kleinberg, Banks, Walker and others). Funsten reviewing twenty cases of dislocation found necrotic changes in six. Figure 19 shows such an area of necrosis ten years after the injury. The symptoms at the age of fifty-two were those of a moderate osteo-arthritis with only minor limitation of function. The fact that years may elapse before the ultimate damage becomes manifest assumes a certain significance in medico-legal decisions.

More extensive changes are seen in the following series, showing the course of events over a period of two and one-half years. (Figs. 20 to 22.)

It is interesting, but not altogether surprising that in those rare cases of traumatic dislocation in childhood the epiphysis may undergo changes identical with Perthes' disease, as has been observed occasionally.

In arthroplasty of the hip joint with those in traumatic dislocation. Consequently, necrosis of the upper femoral end may develop, as has been reported by Phemister and ourselves. Even high osteotomy has in extremely rare cases been followed by necrotic changes within the head.

Congenital Dislocation. Conditions present in traumatic dislocation differ fundamentally from those in congenital luxation. In the latter, the capsule is intact though elongated. The capsular vessels have sufficient time to become adjusted to these alterations.

It is true that in *x*-ray the epiphysis frequently bears some resemblance to Perthes' disease. However, the few microscopic sections secured from such cases are different from those in coxa plana. In contrast to aseptic bone necrosis, prevalent in sections of Perthes' disease, one finds here principally living bone with the characteristics of traumatic infraction. On the other hand, the articular cartilage is fibrillated and partly necrotic, while it is perfectly normal in Perthes' disease. The damage to the articular cartilage may be explained by the traumatism of reduction and partly

by the incongruity of head and acetabulum. However, it is questionable, whether the small number of cases thus examined

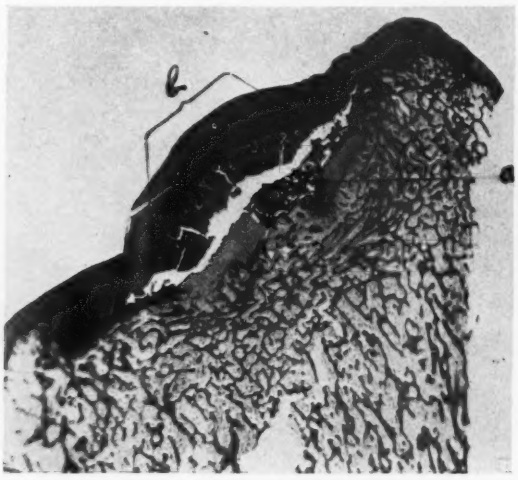

Fig. 25. Specimen of Perthes' disease; *a*, connective tissue; *b*, dead subchondral bone.

allows of any definite conclusions. Be that as it may, one occasionally comes across *x*-ray findings in adult congenital dislocations which correspond fully to those described previously.

Figure 23 shows the hip of a thirty-two year old woman reduced in early infancy. Again we find the wedge-shaped area at the weight bearing sector of the head. She had been practically symptom-free until the age of thirty. Figure 24 shows the hip of a twenty-nine year old female unsuccessfully reduced in early childhood. Here the area of necrosis became fully detached, leaving a clearly visible defect in the center of the articular surface.

Legg-Perthes' Disease. In all the conditions previously discussed the aseptic bone necrosis can without much difficulty be traced back to traumatic interference with blood supply. Not so in Perthes' disease. No explanation, satisfactory in every respect, has as yet been given. Bland embolism, first and foremost considered by Axhausen, has met with little approbation and indeed is objectionable. Since other forms of vascular occlusion as sclerosis or endarteritis are entirely out of the question, one has time and again fallen back to considering traumatism of one form or other. As gross injuries can easily be ruled out by the history, emphasis has recently been laid on minor, repeated or permanent mechanical effects such as experienced almost by the normal use of a limb. The term "microtrauma" has been coined in this connection.

Certain experimental findings lend some color to this theory. Bone tissue like an industrial material was tested for its power of resistance by subjecting it to all sorts of mechanical force. In the course of these experiments, cancellous bone turned out to be very elastic, particluarly if covered with cartilage. Up to a remarkable degree of compression the bone may regain its former shape without so much as fracturing the smallest trabecula. On the other hand—and here the theory sets in—the enclosed medulla tissue with its tiny tender cells and capillaries may not withstand such pressure and die off (by thrombosis rather than embolism). This will then be followed by necrosis of the bony substance proper.

However that may be, the specimen of Legg-Perthes' disease, secured through operation or autopsy reveal the characteristics of aseptic bone necrosis. Fluid was found underneath the articular cartilage (Steele), a finding which suggests colliquation necrosis, not uncommon in necrosis of other tissues. As a rule, sections of specimen show such stages of bone necrosis and replacement as they correspond to the respective phases of the disease: living cartilage, dead bone and dead medulla, or the medulla spaces already revascularized and invaded by new fibrous tissue with the bony framework still necrotic or finally the bone proper in the process of "creeping substitution."

Some pictures as published by Axhausen and myself are here reproduced: Figure 25 shows the sequestrum-like separation of a large part of the epiphysis from the otherwise already reorganized though flattened and deformed head. The epiphyseal disc is completely ossified. The greater part of the epiphysis consists of living bone, the arrangement of its lamellae suggesting

recent reorganization. Figure 26 depicts another specimen of Perthes' disease at the height of its course. At *a* is an area of collapsed dead subchondral bone; *b* denotes a zone of necrotic trabeculae but not collapsed. At *c* the dead medulla is already replaced by "fibrous invasion;" *d* marks a piece of the living epiphyseal plate. At *e* the substitution of the dead trabeculae by new bone is in full swing. Figure 27 shows the femoral head of a seventeen year old boy who for several years had suffered from Perthes' disease. Figure 28 is an *x*-ray of the specimen. A frontal section (Fig. 29) through the middle of the head reveals on gross appearance an area of subchondral necrosis (*a*), the remains of the epiphyseal disc (*b*), a fold of articular cartilage (*c*) and the teres band (*d*). The same at low magnification is Figure 30. *a* is the articular fold, *b* the ligamentum teres. At *c* the subchondral necrosis is made up of collapsed minute fragments surrounded by dead medulla cells. The necrotic part is walled off from the adjacent living bone by a band of vascular connective tissue (*d*), containing numerous giant cells; *e* points at the remains of the disc.

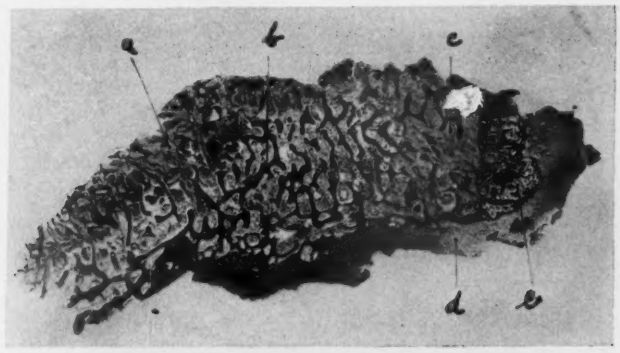

Fig. 26. Another specimen of Perthes' disease; *a*, collapsed dead subchondral bone; *b*, dead bone, not collapsed; *c*, fibrous invasion; *d*, epiphyseal plate; *e*, new bone laid down.

Still a later stage of the disease may be seen in the following series. (Figs. 31–33.) A boy who at the age of six started with hip trouble was thoroughly followed up through the years. At the age of ten the disease had reached its clinical end stage. At fourteen he died from pulmonary disease. On gross inspection the mushroomed head rests on an extremely short neck. An *x*-ray (Fig. 32) shows the deformity and marked structural changes. In the section (Fig. 33) there are still islands of dead bone (*a*) to be seen amidst proliferation of cartilage tissue fibrillated

Fig. 27.

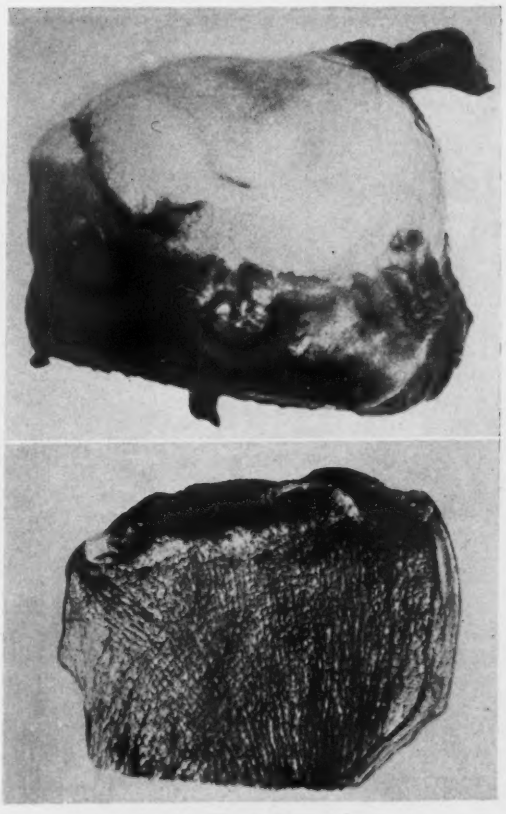

Fig. 28.

Fig. 27. Gross appearance of the head in Perthes' disease.

Fig. 28. *X*-ray of same specimen.

at its superficial layers. Bordering this zone is one of thickened living spongiosa (*b*), its spaces filled with fibrous medulla.

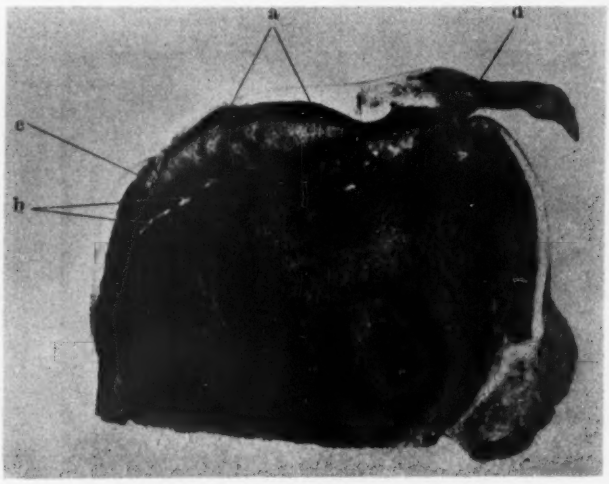

FIG. 29. Cut through femoral head; *a*, subchondral necrosis; *b*, remains of epiphyseal plate; *c*, articular cartilage; *d*, ligamentum teres.

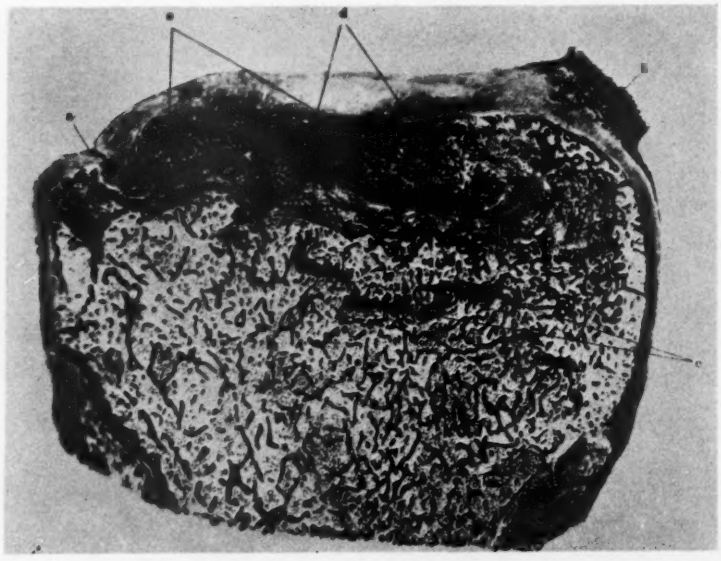

FIG. 30. Same as in Figure 29 on low magnification; *a*, articular cartilage; *b*, ligamentum teres; *c*, fragments of necrotic bone; *d*, connective tissue; *e*, epiphyseal plate.

To find residual islands of dead bone eight years after the onset of the disease and four years after its clinical conclusion is particularly significant in the light of what Phemister has so aptly characterized as a premature arrest of the process of bony replacement.

In this connection the following observation is of interest. A man of thirty years had had Perthes' disease at the age of nine and was subjected to wearing a brace for two years. He remained symptom-free until the age of thirty, then strained himself while bending forward and felt something snap in his hip. Ever since he had marked discomfort on walking. When first seen three weeks after that strain, a slight limitation of flexion and abduction was all that could be found clinically. The *x*-ray (Fig. 34) showed a somewhat flattened, laterally protruding head with a wedge-

shaped piece of demarcated bone at the weight bearing sector. Three and one-half years later he again felt a snapping sensation in his left hip immediately followed by "locking." It unlocked soon thereafter, but left him with a permanent pain in the hip. An *x*-ray (Fig. 35) revealed now a fully detached joint mouse. The development of a free joint body is rare during the acute stage of Perthes' disease; it is extremely unusual as a late complication. That it should have happened in a case so thoroughly guarded from weight bearing through two full years of continued brace wearing makes one wonder.

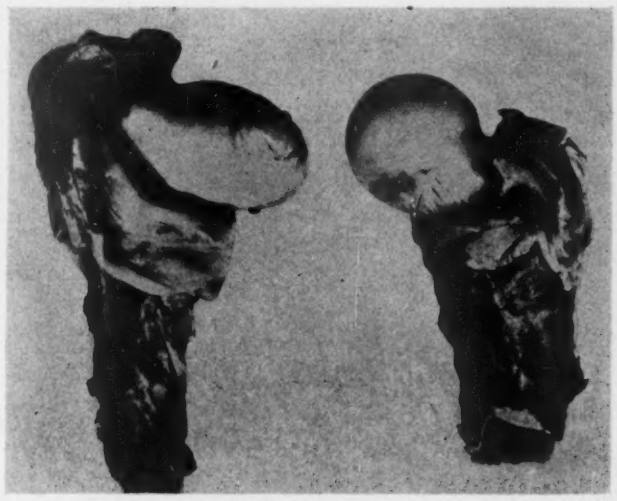

Fig. 31. Specimen of diseased and of normal hip secured by autopsy.

Osteochondritis Dissecans. Much has been argued about the origin of free joint bodies. One school of thought considers the joint mouse as nothing but the result of an intra-articular fracture. The other school, widely accepted, in using the term osteochondritis dissecans expresses the opinion that a part of the joint surface is gradually walled off until it becomes fully detached. It is true that this final separation of the joint body is frequently preceded by trauma. Yet to consider the whole process as a simple fracture is hardly justified. Clinical experience shows that intra-articular fractures consolidate like common ones without ever producing a joint mouse. Also in experiments, one has not been able to obtain free joint bodies, whatever the arrangements might have been. In Figure 36 the result of an experimentally produced articular fracture of the femoral condyle can be seen perfectly healed in three weeks after injury. Figure 37 shows a wedge-shaped piece of the femoral condyle fully incorporated four

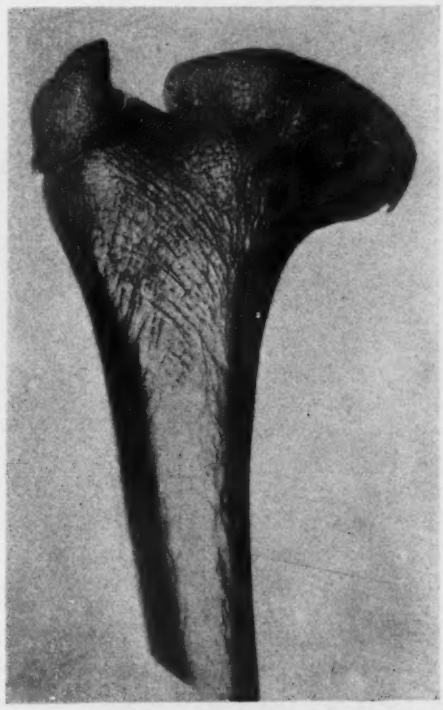

Fig. 32. *X*-ray of deformed head.

weeks after it had been gouged out and immediately re-implanted.

The histological characteristics of a free joint mouse also speak against its being a simple piece of fractured bone. Under its cover of living articular cartilage the bony core is in a state of aseptic necrosis, even when the body is taken out immediately after the alleged trauma. Yet in spite of all these facts, mechanical effects play a rôle. Young adults indulging in vigorous physical activities are mostly afflicted, and it is preferably the knee or elbow joint particularly exposed to mechanical strain. The aforementioned theory of repeated traumatism to lay the groundwork of circumscribed subchondral necrosis may serve to bridge the differences of opinion.

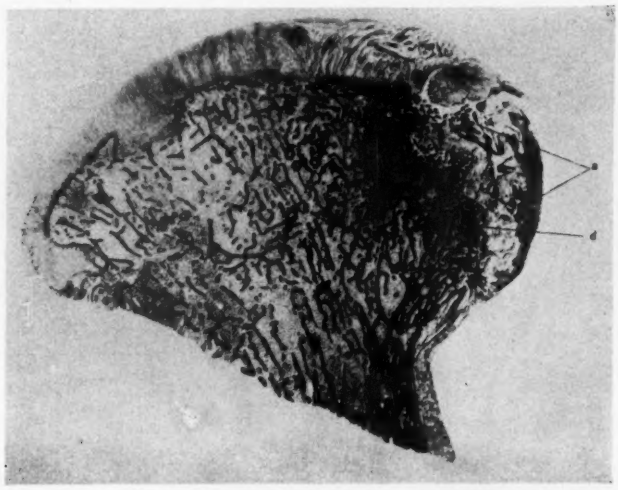

FIG. 33. Low magnification; *a*, residual bone necrosis; *b*, living spongiosa, thickened trabeculae.

FIG. 34. Old Perthes' disease showing a demarcated area at the weight bearing sector.

FIG. 35. Same hip as in Figure 34 over three years later, presenting a fully detached joint mouse.

Osteochondritis dissecans of the hip joint is not a common lesion. I had occa-

sion, fifteen years ago, to report such a condition and since then a moderate number of similar observations appeared in the literature. What made our case remarkable was that the free body had not developed from the weight bearing sector and, secondly, that the head was perfectly round, neither mushroomed nor laterally protruding.

The patient, a twenty-four year old man, had been in perfect health until two months prior to admission. At that time he noticed pain in the knee without preceding trauma. On clinical examination the hip joint allowed only a spring-like motion as if in the state of locking. The *x*-ray showed an almond-sized piece of the head apparently fully detached and originating from the lower medial quadrant. (Fig. 38.) Anterior arthrotomy brought to light a fully detached joint mouse of more than almond size with part of the teres band attached to it. The defect in the femoral head was lined with a layer of reddish-brown connective tissue. The microscopic appearance (Fig. 39) was the usual, well known from the free bodies of knee or elbow joint: the articular cartilage essentially alive, the bony part mainly in the state of aseptic necrosis. In the subchondral zone there was some apposition of new bone, the only feature not quite in line with the ordinary appearance of a joint body.

Caisson Disease. Among the non-traumatic bone lesions based on impairment of circulation, those arising from gas embolism in caisson workers are best understood, largely due to the instructive reports of Phemister and his associates. Their observations have since been confirmed from different quarters. Systematic examinations of caisson workers have brought to light such changes in about one-third of their number with only a very few being actually ill.

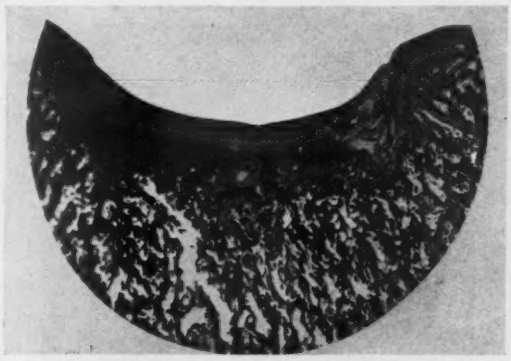

Fig. 36. Experimentally produced articular fracture, healed three weeks after injury.

Fig. 37. Wedge-shaped piece of femoral condyle, fully incorporated four weeks after being gouged out and reimplanted (experiment).

From the material of Bellevue Hospital, Walker reported an interesting case. This patient, twenty-six years ago, had worked as a sand hog and upon rapid decompression instantly developed an acute attack of bends. After several weeks he was able to resume heavy work as a carpenter until 1939 at which time he was grossly incapacitated by increasing stiffness and pain

in his left hip joint. The *x*-ray (Fig. 40) revealed advanced osteo-arthritic changes of this joint and also extensive bone

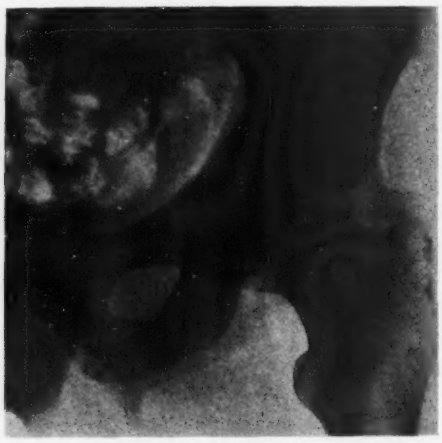

Fig. 38. Osteochondritis dissecans of the hip.

infarctions in the femur and tibia of the same side. (Fig. 41.) These infarctions in the shafts and metaphyses, in silent areas as it were, had never caused symptoms. The osteo-arthritic hip was fused by operation since the other hip was perfectly normal.

Another patient with caisson disease was operated upon by Dr. Krida. This forty-six year old man had worked as a sand hog up to two years prior to admission. From then on he complained of increasing pain and stiffness in his right hip. He had had bends on various occasions. On admission he was only able to move with his right lower extremity crossed over the left one. The right hip appeared locked in full adduction. An *x*-ray of the right hip (Fig. 42) showed a collapse of the entire weight bearing surface, the head protruding laterally out of the socket. The left hip, also to some extent limited in motion, revealed similar changes though perhaps less advanced. Nowhere were there infarctions of the long bones. In the presence of a bilateral involvement of the hips a plastic procedure was decided upon. On exposure of the right hip, the collapsed part of the articular surface proved to be a completely detached piece of articular cartilage with a small layer of subchondral bone attached to it. Upon trimming down the upper femoral end to allow the insertion of a vitallium cup, numerous subchondral cysts were encountered.

Osteo-arthritis. Aseptic bone necrosis is not ordinarily a feature of osteo-arthritis,

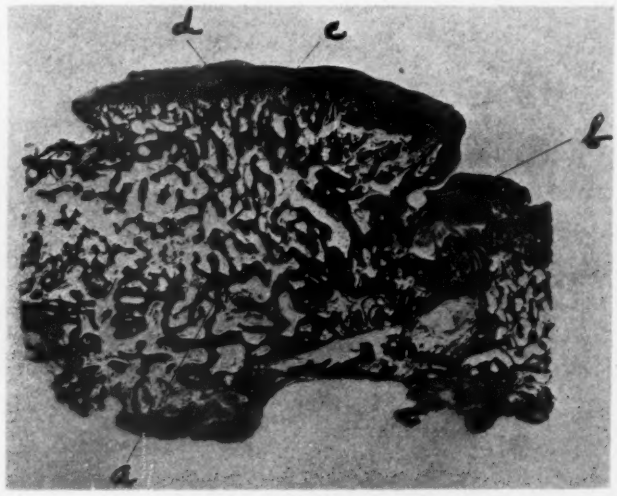

Fig. 39. Same as in Figure 38. Microscopic section of the joint mouse; *a*, dead bone; *b*, dead articular cartilage; *c*, living articular cartilage; *d*, apposition of new bone.

yet occasionally it may be. As to the order of events, it is perhaps more appropriate to say that osteo-arthritis may develop on the basis of an aseptic necrosis of undetermined origin. Since osteo-arthritis is not so much a disease of itself as it is a secondary development resulting from trauma, from incongruity of the joint surfaces or

Fig. 40. Advanced osteoarthritis on the basis of aseptic bone necrosis in caisson disease.

Fig. 41. Femur and tibia of the same side.

other mechanical or inflammatory changes of a joint, it may naturally follow a subchondral bone necrosis. This brings to

Fig. 42. Collapse of the weight bearing sector of the head in another caisson worker.

mind the old controversy whether the initial phases of osteo-arthritis start out from the articular cartilage or the adjacent bone. However that may be, the fact remains that not seldom do osteo-arthritic femoral heads (Figs. 43 and 44) display the familiar collapse and demarcation of the weight bearing sector, ending either in complete detachment or else in eventual re-incorporation of the depressed area. Clinically and in *x*-ray these hips have the same earmarks as those in caisson disease and indeed they are fundamentally of the same nature although the cause of the circulatory disturbance is unknown.

Tuberculosis of the Femoral Head. It may seem strange to include in this collection a condition so entirely different in nature. Yet certain forms of epiphyseal tuberculosis due to vascular occlusion through embolism by tuberculous material may be accompanied by anemic infarcts of a truly aseptic type. (Figs. 45 and 46.) Erroneously each infarcts are sometimes referred to as sequestrum. Only the super-

imposed pyogenic infection would bring about sequestration. Without mixed infection the necrotic area is aseptic and closely resembles in microscopic section the picture of osteochondritis dissecans prior to the detachment of the joint body.

FIG. 43.

FIG. 44.

FIGS. 43 AND 44. Collapse of the weight bearing surface in osteoarthritis of undetermined origin.

SUMMARY

The pathological disorder of the femoral head is largely one of aseptic necrosis. Its significance in fractures of the femoral neck is generally appreciated. The rôle it plays in traumatic dislocation has in recent years been more and more recognized. From epiphyseal separations ischemic necrosis may or may not ensue. Congenital dislocation may also entail circulatory impairment for the femoral head. While in Perthes' disease the radiological and pathological train of events is well known, the cause of the epiphyseonecrosis is still a matter of conjecture. The same is true in osteochondritis dissecans and in those cases of osteo-arthritis which are characterized by collapsed and more or less demarcated areas of necrotic bone in the weight bearing sector. Embolic interruption of circulation to the femoral head is undisputed in caisson disease alone.

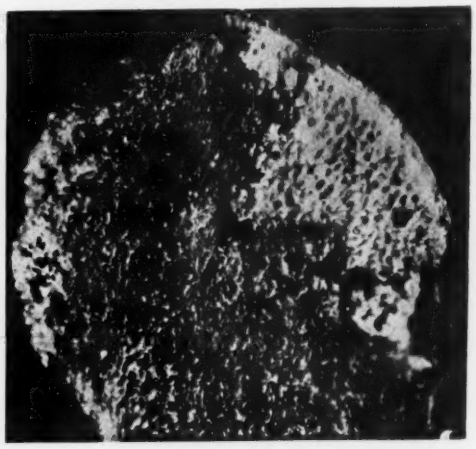

FIG. 45. Anemic bone infarct in tuberculosis of the hip.

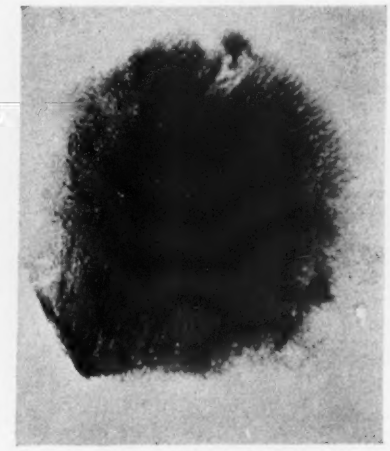

FIG. 46. *X*-ray of same specimen as in Figure 45.

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SEDATION IN PATIENTS WITH ACUTE HEAD INJURY*

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THE management of the restless patient with cranial trauma is often trying and difficult. Restlessness of varying degrees, sometimes to the point of requiring restraint, is frequently encountered and is undesirable. Management calls for recognition and removal of the causes for the restlessness. The use of analgesic sedative and hypnotic drugs should be a final resort. The selection of the most efficacious and at the same time the least disturbing to the restorative processes has been of interest to us.

TECHNIC

The technic used in this study is the same as described in a previous paper.[1] The cerebrospinal fluid pressure was observed continuously for one and a half to three hours by attaching a water manometer to a needle inserted between the second and third or third and fourth lumbar vertebrae; averages were recorded every five minutes. The drug or drugs were administered about fifteen minutes after the start of the experiment. In the group given chloral-bromide, repeated punctures were made at different lumbar interspaces to observe the spinal fluid pressure. The number of drops of spinal fluid lost during the puncture was noted. The blood pressure and respirations were recorded every fifteen minutes. The effect of the drugs upon pain, motor activity, color and general appearance were also noted.

RESULTS

In this paper are discussed the results of studies of chloral-bromide, and of codein and nembutal. The effect of morphine and sodium phenobarbital upon patients with cranial trauma was presented in detail in a previous report.[1] Morphine was found to cause a consistent and undesirable rise in cerebrospinal fluid pressure in cases of severe head injury. The respiratory rate was usually lowered and in some instances cyanosis occurred. In patients without apparent pain, or with no apparent cause for pain, the effect on motor activity was not uniform. In some, the restlessness continued; in others, a profound hypnosis was produced. Sodium phenobarbital in 5 gr. intramuscular doses did not influence the cerebrospinal fluid pressure, respirations, blood pressure or pulse. In many instances, it had no appreciable sedative influence.

Chloral-bromide Solution. A solution of 5 gr. of chloral and 15 gr. of sodium bromide in one ounce of water was administered to seven patients with cranial trauma, rectally in four instances and orally in three cases. The cerebrospinal fluid pressure was recorded by repeated punctures. (Fig. 1.) There was no increase in the fluid pressure and the drug was found to have little sedative effect except in one patient in whom a deep sleep lasting for one hour was produced.

Codein and Nembutal. One and one-half gr. of codein intramuscularly and 3 gr. of nembutal orally was administered in fourteen patients. Both were given intramuscularly in four cases. In Table I, the pertinent data in these cases are given. All but three had fractured skulls, and among thirteen, including three without fracture of the skull, there was bloody or xanthochromatic spinal fluid. In one instance, a significant rise in the cerebrospinal fluid pressure occurred (Case 2, with a rise of 205 mm. at the end of one hour. The pressure then dropped to below the initial level at the end of ninety-five minutes). A sedative effect was obtained in every instance except two. The patients were usually asleep ten minutes after the administration of the drugs. A slowing of

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the pulse was noted; the respirations also tended to lower; there was little variation of the blood pressure. Of the various drugs used, the combination of codein and nembutal was found to be superior. It was found that these drugs could be repeated to promote continued restfulness and that fractions of the original dose were often effective as maintenance doses. (Fig. 2.)

TABLE I

SYNOPSIS OF HEAD INJURY CASES GIVEN NEMBUTAL GR. 3 BY MOUTH OR INTRAMUSCULARLY, AND CODEIN GR. 1½ INTRAMUSCULARLY

Case No., Sex	Age	Spinal Fluid	Initial Pressure	Highest Pressure	Pressure at End	Net Change	Day of Test	Fractured Skull	Fluid Loss	Vital Functions		
										Blood Pressure	Pulse	Respiration
1M	66	Xantho.	155	155	150	−5	9	Yes	2 drops	150/75 130/60	68-64	18-16
2M	51	Bloody	245	450	220	+205	12	No	10 drops	145/90	85-80	20-18
3M	57	Slightly Bloody	250	270	265	+20	2	Yes	3 drops	140/90	92-86	32-28
4M	27	Bloody	720	750	590	+30	2	Yes	10 drops	130/80	56-50	16
5M	50	Clear	165	210	140	+45	11	Yes	None	125/80	84-74	23-19
6F	26	Clear	250	280	250	+30	2	Yes	5 drops	110/70	92-86	24-20
7F	58	Slightly Bloody	190	230	240	+40	8	No	3 drops	158/100 150/90	85-80	16-14
8M	24	Xantho.	270	300	300	+30	9	No	5 drops	120/70	96-94	16-13
9F	21	Xantho.	250	300	205	+50	5	Yes	3 drops	110/85 115/80	90-85	13-12
10M	?	Xantho.	350	400	275	+50	10	No	5 drops	130/75	80-68	15-12
11M	47	Xantho.	125	145	145	+20	5	Yes	8 drops	106/74	84-76	17-15
12M	66	Bloody	475	475	295	−180	5	Yes	10 drops	106/74	69-58	17-15
13M	56	Clear	260	310	205	+50	11	Yes	4 drops	145/100	78-70	15-14
14M	51	Clear	270	330	320	+60	12	Yes	3 drops	140/100 150/110	84-80	20-14
15M	39	Bloody	245	280	250	+40	9	Yes	5 drops	100/76	84-78	21-22
16M	?	Clear	158	158	150	−8	8	Yes	3 drops	130/90	82-76	18-17
17M	58	Bloody	130	150	150	+20	3	Yes	4 drops	110/56	82-72	18-16
18F	21	Bloody	215	300	300	+85	2	Yes	2 drops	104/60	65-63	16

COMMENT

There are several factors which contribute to the production of restlessness in the injured patient apart from the stimulation due to cerebral damage. These include distention of the urinary bladder, an inadequate airway, pain from associated injuries, and discomfort from a soiled bed, noise, handling of the patient, restraints, dehydration and abdominal distention. Before sedative drugs are indicated, such factors must be considered and controlled. Their control is dependent mainly upon constant nursing care and close observation.

The distended bladder may be catheterized as early as possible and usually later catheterizations may not be necessary. An adequate airway is provided by the position of the patient free from flexion of the neck and by a conscientious effort to remove all collecting mucus with a suction apparatus. Oxygen by means of a catheter placed in the nasopharynx may be of benefit. The patient must not be fed if any doubt exists as to the integrity of the swallowing reflex except by tube administration. Pain from associated injuries must be relieved; an adequate intake of fluid is advisable (2,000–2,500 cc.). Freedom from noise, light, movements, extremity restraints and a wet bed is helpful in promoting restfulness. When these conditions have been fulfilled, there are patients who still remain active and therefore require sedative drug therapy. In these

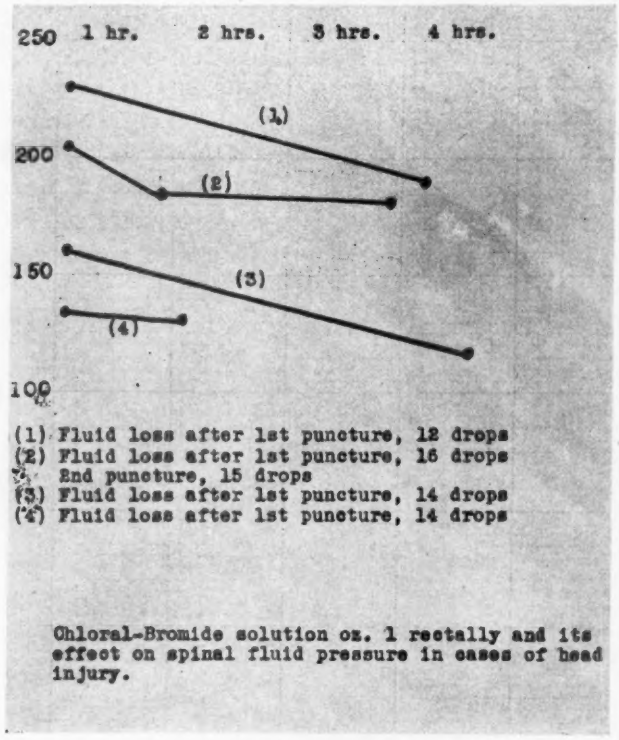

FIG. 1.

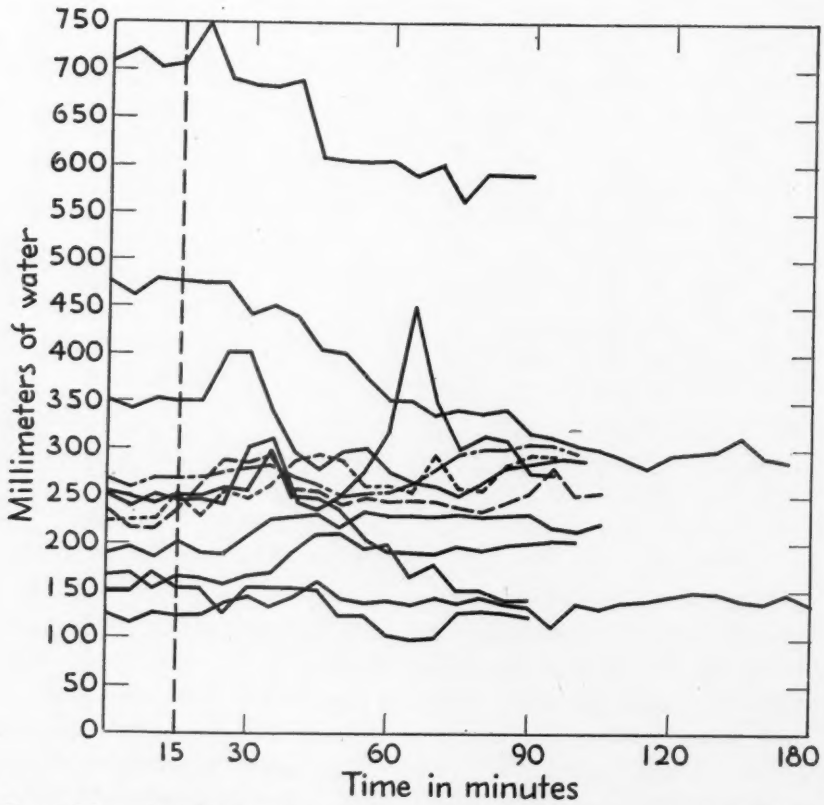

FIG. 2. The spinal fluid pressure of the first twelve cases summarized in Table 1. These patients were given 1½ gr. of codein and 3 gr. of nembutal by mouth or intramuscularly.

studies we have now become more familiar with the effects of morphine, sodium phenobarbital, codein and nembutal, and chloral-bromide solution.

From clinical observations of the drugs evaluated, codein and nembutal appear to be the sedatives of choice, most efficaciously used in combination. They usually produce rest and the sleep brought about by their use approximates normal sleep. The action of these drugs in combination is rapid; and if the patient is not disturbed, the sleep may continue from one to five hours. The cerebrospinal fluid pressure is not significantly disturbed; there are no undesirable changes in the vital functions. However, their use should be discontinued as soon as possible. Routine administration of any sedative drug is condemned. When restlessness continues for many days or weeks, it may be desirable to change to another drug.

In material which is to be published in detail elsewhere, oxygen content, percentage of saturation and carbon-dioxide content were recorded in the normal, morphinized and nembutalized dog. The oxygen content and percentage of saturation tend to decrease slightly following the use of the drugs as also noted by McClure, Hartman, Schnedorf and Schelling.[2] However, the arteriovenous difference remained about the same as in the normal which suggests satisfactory utilization of the oxygen by the brain. Of course, it is admitted that simultaneous accurate blood-flow studies alone can prove this point beyond dispute. Although the available oxygen may be adequate in amount, its utilization by all or certain groups of cells of the nervous system may not be satisfactory in the presence of sedatives and narcotics. The contributions of Michaelis and Quastel,[3] Quastel,[4] and Gerard[5] suggest that sliced brain tissue does not absorb as much oxygen in a solution of a barbiturate but that apparently no lasting damage is done to the tissue, for the reaction is reversed and normal absorption recurs after the same tissue is taken out of the barbiturate environment. As to the similarity of results in experiments *in vitro* compared with findings *in vivo*, one may say that surviving tissue undergoes many chemical changes tending to lower its ability to carry on metabolic activity. The dosage of the drug may also be different under varying circumstances. The work of Stone[6] indicates that phosphorous compounds and lactic acid in the brain change with anoxia and death but no such change obtains with the use of nembutal or morphine alone. It is our belief that although histotoxic anoxia may be a factor, the judicious use of certain narcotic and sedative drugs in moderate doses is justifiable and proper when needed.

From our experience, the use of morphine should be avoided, except when its use becomes imperative as an analgesic. Objections to its administration outnumber those of the codein and nembutal.

CONCLUSIONS

The use of codein in combination with nembutal is recommended for the restlessness due to cerebral injury after secondary disturbing factors have been eliminated. Codein and nembutal is effective and least harmful based upon a study of the cerebrospinal fluid pressure, pulse, respirations, blood pressure and motor activity. Their use should be discontinued as soon as possible and their routine use is condemned. The use of morphine should be avoided except when it becomes imperative for relief from pain.

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CEEPRYN*

CLINICAL AND BACTERIOLOGICAL STUDIES

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CEEPRYN (brand of cetylpyridinium chloride) is a quarternary ammonium compound which possesses a very high degree of germicidal activity, both in the absence of serum and in the presence of 10 per cent serum. It has been shown in the laboratory to be effective against a wide variety of pathological organisms, particularly against those organisms ordinarily considered responsible for cutaneous contamination and wound infections.

Toxicity studies have shown that this quarternary ammonium compound has a very low toxicity, considerably lower than similar compounds containing the benzyl radical.

Cetylpyridinium chloride (Ceepryn brand), is a white, crystalline powder of definite chemical composition, readily soluble in water, alcohol and acetone. Ceepryn, in solution forms a neutral mixture and has the quality of lowering surface tension; therefore, solutions of Ceepryn are quite detergent.

There were four features of this new germicide that prompted its study and clinical use, namely, its high germicidal activity on a wide variety of organisms; its relative non-toxicity; its high detergence, and the fact that it did not contain any phenols or heavy metal, such as mercury, which in some cases is irritating.

In March, 1940, the use of this tincture was made routine on all the wards of the Youngstown Hospital for complete investigational study.

Ceepryn Tinted Tincture 1:200. Since we noted from laboratory studies that this type of compound is somewhat inactivated by the presence of soap, we believed it was particularly adaptable to our routine method of preoperative preparation of the skin. The routine we used in all operations and all technics is as follows: When possible, the night before (or in case of emergency, immediately prior to operation) the patient has at the bed, a dry shave of the part to be prepared for surgery. There is no sterile dressing placed over the part. When the patient is brought to the operating room, the operative field is scrubbed twice, thoroughly, with ether using two separate sponges. The technic with Ceepryn is then to apply two coats of Ceepryn tincture 1:200, the first being allowed to dry partially, before the second coat is applied. We have used the above technic with this new germicide in every laparotomy, amputation (breast, extremities, etc.), dilatation and curettage, excision of glands of the neck, ligation of varicose veins, etc.

At Youngstown Hospital we have had an average of 6,000 surgical operations per year. Therefore, this clinical study covers the results in around 18,000 cases.

With one feature of Ceepryn, have we been particularly impressed, and it is this feature which we wish to stress particularly in this report: There has been no instance of irritation, and there have been evidenced no idiosyncrasies to the drug. Added to this is the important clinical point that we have had no postoperative infections during this period.

The above outlined technic of preoperative preparation of the skin, offers the following advantages in our estimation: (1) it is time saving; (2) it is fool-proof (eliminating a certain stated period of

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scrubbing) and (3) it is cheaper (the process eliminating soap, alcohol, etc.). These three points, coupled with the fact that we have observed no irritation and experienced no infections, has made us consider that Ceepryn is, in our experience, the closest approach to the ideal cutaneous disinfectant that we have been able to find.

There are also certain practical points concerning the use of Ceepryn that we wish to mention. When an appendectomy is done, for example, we have not used the purse-string type of suture, inverting the stump. When the distal end of the appendix has been severed, we touch the proximal end with phenol, then with alcohol, then with Ceepryn tincture 1:200; in addition we paint the entire cecum and the rough edges of the mesocolon with the tincture. We have experienced no irritation from this procedure.

Another practical feature in the use of this preparation is, that contrary to certain mercury antiseptics, it can be used to paint the tissues before the application of elastoplast without resulting irritation. In the application of Unna's Paste boot, the whole leg is covered with Ceepryn tincture 1:200. These boots have been allowed to remain on for six or eight weeks in men working in the steel mills, in an environment of high temperature. In 150 patients so treated, there has been no irritation.

Bacteriological Studies of Ceepryn Tinted Tincture 1:200. The bacteriological investigation of a series of patients, upon whom Ceepryn tincture was to be used, applying the above preoperative technic, was undertaken to determine the efficacy of Ceepryn tincture as a cutaneous disinfectant for the operative field.

Fifty unselected, routine consecutive cases were studied. As most of the surgeons and their assistants were unaware of this study, there were no deviations in the precautions taken by them in the preoperative technic.

The following culture media were used in our study: Tryptose phosphate broth, blood agar and dextrose agar. Each batch of culture media was first tested before use and was found to be highly satisfactory for the cultivation of streptococcus, pneumococcus, Staphylococcus albus, Staphylococcus aureus and Bacillus coli.

Three cultures were made, one in each media, from the skin of the preoperative field as soon as the patient was placed on the operating table and the preliminary preparatory dressings removed. Three cultures were taken on the same kind of media after the application of 1:200 solution of tincture of Ceepryn as soon as it dried and finally three cultures were made on the same kind of media after the operation was completed, just before the surgical wound was dressed. In all, nine cultures were taken from each case.

Cultures were immediately incubated at 37.5°C. and were observed and read at the end of twenty-four hours, forty-eight hours, and seventy-two hours. All cultures were taken with sterile cotton swabs, on wood applicators.

The results obtained were as follows: All cultures from the operative field before the application of 1:200 tincture of Ceepryn were positive. All cultures from the operative field, after the application of a 1:200 tincture of Ceepryn were negative. Forty-five cultures from the operative field after the operation was completed and before the surgical wound was dressed were negative. Five cultures were positive.

The organisms found in all cultures from the operative field before Ceepryn was applied were: in twenty-five cases, Staphylococcus albus, in fourteen cases, Staphylococcus albus and an air bacillus, in one case Staphylococcus albus and streptococcus, in one case streptococcus alone, one case colon bacillus alone, in two cases colon bacillus and staphylococcus, in one case an air bacillus alone, in two cases Pneumococcus and Staphylococcus albus, in one case pneumococcus and an air bacillus, in two cases Micrococcus catarrhalis and Staphylococcus albus.

In the five positive cultures obtained after the operation was completed were:

No.	Operation	Culture before Ceepryn Application	Culture after Ceepryn Application	Culture after Completion of Operation
1	Appendectomy	Positive Large gram positive air bacillus Staphylococcus albus	Negative	Negative
2	Herniotomy	Positive Staphylococcus albus	Negative	Negative
3	Median laparotomy	Positive Staphylococcus albus	Negative	Negative
4	Appendectomy	Positive Staphylococcus albus	Negative	Negative
5	Saphenous ligation	Positive Large gram positive air bacillus Staphylococcus albus	Negative	Negative
6	Appendectomy	Positive Staphylococcus albus	Negative	Negative
7	Appendectomy	Positive Large gram positive air bacillus Staphylococcus albus	Negative	Negative
8	Median laparotomy	Positive Large gram positive air bacillus Staphylococcus albus	Negative	Negative
9	Tumor of knee	Positive Staphylococcus albus	Negative	Negative
10	Breast tumor	Positive Staphylococcus albus Large gram positive air bacillus	Negative	Negative
11	D & C	Positive Staphylococcus albus Large gram positive air bacillus	Negative	Diphtheroid bacillus
12	Appendectomy	Positive Staphylococcus albus	Negative	Negative
13	Appendectomy	Positive Staphylococcus albus	Negative	Negative
14	Cholecystectomy	Positive Streptococcus	Negative	Negative
15	Saphenous ligation	Positive Staphylococcus albus	Negative	Negative
16	Saphenous ligation	Positive Staphylococcus albus	Negative	Negative
17	Median laparotomy	Positive Large gram positive air bacillus	Negative	Negative
18	Herniotomy	Positive Large gram positive air bacillus Staphylococcus albus	Negative	Negative
19	D & C	Positive Staphylococcus albus Streptococcus hemolyticus	Negative	Negative
20	Median laparotomy	Positive Staphylococcus albus	Negative	Negative
21	Perineal repair	Positive Staphylococcus albus Large gram positive air bacillus	Negative	Negative
22	Median laparotomy	Positive staphylococcus Albus	Negative	Negative
23	Median laparotomy	Positive Staphylococcus albus Large gram neg. & pos. air bacilli	Negative	Negative
24	Circumcision	Positive Staphylococcus albus Large gram positive air bacillus	Negative	Negative
25	Saphenous ligation	Positive Staphylococcus albus	Negative	Negative

No.	Operation	Culture before Ceepryn Application	Culture after Ceepryn Application	Culture after Completion of Operation
26	Appendectomy	Positive Staphylococcus albus Large gram positive air bacillus	Negative	Negative
27	Saphenous ligation	Positive Staphylococcus albus	Negative	Negative
28	Cholecystectomy	Positive Staphylococcus albus	Negative	Negative
29	Median laparotomy	Positive Staphylococcus albus	Negative	Negative
30	D & C	Positive Pneumococci Large gram positive air bacillus	Negative	Staphylococcus albus
31	Repair D & C	Positive Colon bacillus	Negative	Negative
32	Median laparotomy	Positive Staphylococcus albus	Negative	Negative
33	Cholecystectomy	Positive Staphylococcus albus	Negative	Negative
34	D & C	Positive Staphylococcus albus Colon bacillus	Negative	Staphylococcus albus
35	Herniotomy	Positive Staphylococcus albus	Negative	Negative
36	Median laparotomy	Positive Staphylococcus albus	Negative	Negative
37	Appendectomy	Positive Staphylococcus albus	Negative	Negative
38	Cholecystectomy	Positive B. coli Staphylococcus albus	Negative	Negative
39	Saphenous ligation	Positive Large gram positive air bacillus Staphylococcus albus	Negative	Negative
40	Saphenous ligation	Positive Staphylococcus albus	Negative	Negative
41	D & C	Positive Staphylococcus albus Micrococcus catarrhalis	Negative	Staphylococcus albus
42	Appendectomy	Positive Staphylococcus albus	Negative	Negative
43	Herniotomy	Positive Staphylococcus albus Pneumococci	Negative	Negative
44	Saphenous ligation	Positive Staphylococcus albus	Negative	Negative
45	Cholecystectomy	Positive Staphylococcus albus Pneumococci	Negative	Negative
46	Median laparotomy	Positive Staphylococcus albus	Negative	Negative
47	Appendectomy	Positive Large gram positive air bacillus Staphylococcus albus	Negative	Negative
48	Head case	Positive Staphylococcus albus	Negative	Negative
49	D & C	Positive Staphylococcus albus	Negative	Large gram negative bacilli
50	Saphenous ligation	Positive Staphylococcus albus Micrococcus catarrhalis	Negative	Negative

In one case an air bacillus alone, three cases Staphylococcus albus alone and in one case a diphtheroid bacillus alone.

In referring to the table it will be noted that the positive cultures obtained after the completing of the operation were from dilation and curettage operations. (Table 1.)

In positive cultures, the growth appeared during the first twenty-four hours, and those cultures in which there were no growths found in twenty-four hours, such cultures remained sterile after seventy-two hours.

Ceepryn Aqueous Solution 1:1000. Since October, 1941, we have used Ceepryn aqueous solution 1:1000 for all surgical procedures in which a germicidal solution, irrigant, or wet dressing was indicated. Ceepryn appealed to us particularly because of the fact that it did not contain any heavy metal, which might cause a chemical irritation, and it is isotonic. It was highly germicidal against the streptococcus and staphylococcus, which is the usual contaminant where irrigations or wet dressings are indicated, and its high detergency would permit the penetration of the germicide intimately with the tissues under treatment, and would help in removing necrotic tissues.

Ceepryn aqueous solution 1:1000 was used in wet dressings for felons, glomus gangrene or thrombosis, and other minor conditions such as ingrown toe-nail and paronychia. The usual technic was the use of wet dressings for two to three days. Good results were obtained in all cases and it was significant there was no maceration nor wrinkling of tissues.

This solution was used prior to the injections of all types by means of a swab saturated with the solution. It was found that the solution cleansed the area to be injected very thoroughly and was much superior to alcohol, which is usually used for this purpose.

This solution was found very useful in contused wounds requiring débridement. The technic employed here was as follows: the contused wound was cleansed with benzene, followed by irrigation and scrubbing, if necessary, with Ceepryn aqueous solution 1:1000.

This solution was found particularly interesting and useful in the treatment of extensive abrasions or brush burns, particularly in those cases in which small particles of foreign material were embedded in the superficial layers of the skin. The technic here was first to wash the part thoroughly with the 1:1000 solution and then to apply continuous wet dressings for two or three days. At the end of this time, when the dressing was removed it was found that a gray-green slough was present which would come off readily without leaving any bleeding points. There was no maceration of the tissues from the use of this technic.

For scalp wounds the detergence of this solution was particularly valuable, since swabs saturated with the solution could be used to clean the scalp, the friction of the swab causing quite a bit of foam which facilitated shaving. It was of particular interest, that on the scalp and on other hairy portions of the body which require swabbing prior to suture, there was no folliculitis, which can often become quite troublesome in areas of this nature.

In the treatment of Trichomonas vaginalis vaginitis, Ceepryn aqueous solution was used to cleanse the vagina following which a 1:200 Ceepryn powder was used. (This powder was supplied also on an experimental basis.) This combined technic in the treatment of trichomonas infection was found excellent in several cases.

It was noted in many cases that wounds, which contained a great deal of detritus, were readily cleansed of all tenacious material by irrigation with Ceepryn aqueous solution 1:1000.

Occasionally, this solution was used following rib resection to irrigate empyema following pneumonia. It was found that the cavity was cleansed, and healing and recovery was much faster in those cases in which this solution was used. This was

most likely because of the fact that Ceepryn solutions are detergent, and they permit the germicide to come into contact with the causative organisms.

In the peripheral vascular clinic, in the treatment of trophic ulcers, Ceepryn aqueous solution was found to be extremely useful in that it cleansed the ulcer thoroughly, and also removed the scaly dead skin from the area surrounding the ulcer. Quite often the tissues surrounding the trophic ulcers are quite sensitive, and in no case was irritation produced, even though it was often necessary to employ vigorous scrubbing.

SUMMARY*

1. Ceepryn tincture 1:200 has been used routinely in our operative cases at the Youngstown Hospital for three years (totalling around 18,000 cases). During this time there has been observed no irritation and no single instance of infection.

2. A special preoperative technic, particularly applicable to this germicide, is outlined.

3. Complete bacteriological studies on a series of fifty surgical patients, selected at random, showed Ceepryn tinted tincture 1:200 is a highly effective, non-irritating, cutaneous disinfectant for securing a sterile operative field.

4. Ceepryn aqueous solution 1:1000 has been used for the past twenty-one months on all surgical patients requiring a germicidal irrigant or wet dressing. In this connection, Ceepryn seems to be of particular value because of its combination of high germicidal activity and detergence.

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PERSISTENCE OF PAIN AFTER APPENDECTOMY

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NUMEROUS reports in the literature state that there is a considerable proportion of patients who fail to obtain relief of pain following appendectomy. Failures predominated among the group having chronic appendicitis as compared to the group who suffered acute attacks.

In the majority of the reported cases in which appendectomy failed to bring relief, the main symptoms before operation consisted of pain and tenderness. Nearly all of the writers quoted agree that right iliac pain and tenderness are invaluable symptoms in the diagnosis of acute appendicitis, but when taken alone they are practically valueless as evidence of chronic appendicitis. For years past, surgeons have recognized the fact that appendectomy frequently fails to relieve pain and tenderness in the right lower quadrant and they have made persistent search to find some explanation for these symptoms other than the appendix.

Among the larger groups reported, Alvarez made a comprehensive survey of 255 cases. Only two patients in this group obtained a complete cure of their symptoms. He states that a patient, especially an adult who submits to appendectomy, having never had an acute attack, has but one chance in a hundred of getting a permanently satisfactory result; also that there was one chance in a hundred of dying from the operation. There were four patients who had partial relief and four who lost their symptoms for several years making a total of four chances in a hundred of getting some relief. Twenty-four per cent of this series, however, became decidedly worse. Some who could stand their distress and could still keep at work prior to operation could never work afterward. He concluded, therefore, that chances of losing heavily as compared with the chances of getting cured were thirty to one, and the chances of losing heavily as compared to getting some help were six to one. Approximately three out of four of his patients could not remember having experienced even temporary improvement after the operation.

Segal and Heinemann state that the diagnosis of chronic appendicitis is an erroneous one in each instance it is made, and indicate that pain and tenderness of the right lower quadrant is not a reliable sign of chronic appendicitis. They had arrived at these conclusions on the basis of postoperative persistence of the patient's symptoms.

Lewis reported that 40 per cent of appendectomies for chronic appendicitis failed to relieve the original symptoms.

Lichty advises against making a diagnosis of chronic appendicitis unless there is a definite history of a characteristic acute attack. Many of his patients became worse. He has seen patients who had been operated upon fourteen times, the first operation having been done for a supposed chronic appendicitis.

Warren and Ballentine in commenting upon a follow-up study of 138 cases of chronic appendicitis reports 24.6 per cent of patients unimproved, and .7 per cent worse. These cases were all reported as having normal appendices, although often operated upon during an attack of pain in the right quadrant. Their total of cured and improved patients in this series was approximately 75 per cent, as compared to the series of 255 patients reported by Alvarez in which 2 patients were cured and 8 improved, which is 4 per cent.

Other observers have reported similar results, the failures varying from 10 to 70 per cent.

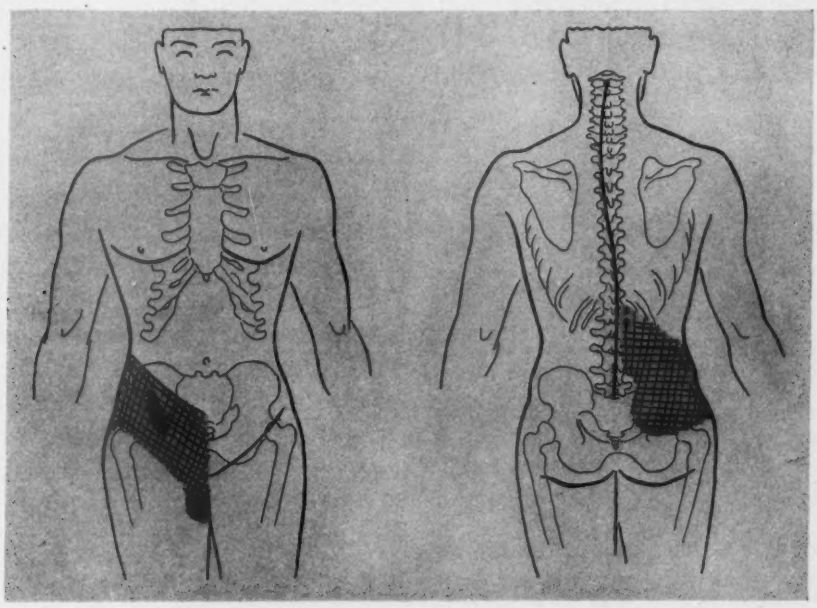

Fig. 1. E. G., age thirty-one, female: chief complaint: pain in the right lower quadrant, duration: seven years; appendectomy several years ago with no relief of her original complaint. The patient was advised sometime later that she had adhesions and possible trouble with an ovary. Examination revealed segmental tenderness involving D12 and L1 on the right side. The patient had a scoliosis and a three-fourths of an inch shortening of the right leg. A heel lift and a paravertebral infiltration of D12 and L1 caused complete disappearance of pain and tenderness in all areas. The injection was repeated on several occasions. Diathermy was administered to the dorsolumbar spine. The patient made an excellent recovery. The dark area represents the point of spontaneous pain. The hatched area denotes the zone of associated tenderness.

Carnett, and later Carnett and Bates were the first to state definitely that the pain in these patients was due to an intercostal neuralgia. In other words, the pain was in the parietes or abdominal wall, and was not due to painful stimuli from diseased viscera. Our observations over a period of years have confirmed the findings of Carnett and Bates.

Most of the patients who complained of chronic pain and tenderness of the lower right quadrant proved to be suffering from an abdominal wall neuralgia of somatic origin. Some of these patients had submitted to surgery, others had not. Many had undergone gastrointestinal and genitourinary studies with negative findings.

Reasons for concluding that these patients are frequently suffering from pain of parietal neuralgia are based upon the following observations:

1. That the *tenderness* which is associated with the pain is *segmental in outline.* If carefully elicited, tenderness is found not only in the lower right quadrant, but in the upper inner aspect of the thigh, the costovertebral angle, the lumbar region and the upper half of the buttock. Clinically, visceral pain is a most infrequent cause of segmental tenderness.

2. Segmental tenderness is usually associated with some disturbance *in or near the vertebral column;* it may be the roots before or after their exit, disease of the spinal nerves, or irritation of soft structures close to the spine.

3. In patients with segmental pain and tenderness, paravertebral infiltration of a local anesthetic directly into the area of the trunks which supply the painful and tender abdomen causes immediate quies-

cence of pain and tenderness to both superficial and deep palpation. Visceral pain cannot be controlled in this manner.

4. Paravertebral infiltration has not controlled pain which later proved to be due to visceral disease, or due to intraspinal lesions.

5. Many patients with chronic pain and tenderness of the abdominal wall obtain no relief by surgery, and improve or are cured of their complaints when attention is directed to the spine.

6. Many patients with chronic segmental pain and tenderness of the lower abdominal quadrants obtain relief by heel lifts, postural correction, and physical therapy to the dorsolumbar spine with no other form of treatment.

7. The majority of patients with segmental pain and tenderness obtain either improvement or cure of their complaints when treatments are directed to the spine rather than to any of the peripheral areas of spontaneous pain, or to the abdominal viscera.

The most important cause of persistent segmental pain and tenderness of the lower abdominal quadrants, is the susceptibility of the dorsolumbar spine to trauma and postural strain. Among other causes are the various factors which are commonly responsible for parietal pain elsewhere in the body, very often some form of upper respiratory infection.

Treatment may be outlined as follows: (1) *Removal of foci of infection;* (2) *postural correction:* pelvic tilt for lordosis, a heel raise for a shortened lower extremity to correct scoliosis; postural corrective exercises of Goldthwaite; (3) *physical therapy:* this should be applied to the spine over the irritated trunks and not to any of the peripheral areas of spontaneous pain; (4) *nerve block:* paravertebral infiltration of the trunks which supply the tender and painful area is the most rapid and dependable method of causing quiescence of the patient's symptoms; (5) *mechanical support:* these should be used only where there is a definite lesion requiring support, as determined by *x*-ray and other studies.

CONCLUSIONS

1. Persistent pain following appendectomy is commonly caused by an abdominal wall neuralgia as evidenced by the segmental tenderness which is usually assoally associated with this condition.

2. Treatment should be directed to the spine and paravertebral nerve trunks, rather than to peripheral zones of pain or to the abdominal viscera.

3. Surgery should not be repeated in the presence of segmental tenderness, until a segmental neuralgia is ruled out.

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CARDIOVASCULAR AND RESPIRATORY EFFECTS FROM CELIAC GANGLIA STIMULATION IN MAN*

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SURGEONS and anesthetists have frequently observed circulatory and respiratory disturbances following manipulations of the viscera during intra-abdominal operations. Many laboratory experiments have been undertaken to define and explain these disturbances. Such investigations have regularly been concerned with stimulation of the viscera itself rather than the pathways for innervation and are restricted to laboratory animals as subjects. Little attention has been given to celiac plexus stimulation and to the circulatory and respiratory changes that may result. In a previous communication, it was found that faradic stimulation of the celiac plexus in the dog resulted in predominant cardiovascular and respiratory responses characterized by a rise in arterial and venous pressures, a decrease in pulse pressure, a sinus tachycardia and an inspiratory apnea.[1] It was suggested that such a reponse was dependent upon an afferent arc of the sympathetic nervous system. In this present study, the experiments were repeated in man.

PROCEDURE

The subjects in this investigation were six patients on whom seven surgical procedures were completed by one of us (L. M.) for treatment of hypertension or other vascular disturbances. The patients were anesthetized with cyclopropane or nitrous oxide-oxygen-ether sequence utilizing the carbon dioxide absorption technic. An endotracheal airway with an inflatable cuff was employed in each instance. During operation the right or the left celiac ganglia and corresponding splanchnic nerves and sympathetic ganglia (L_1, L_2) were exposed through a dorsolateral incision. Before these structures were excised or severed, they were subjected to stimulation using the Harvard induction coil with two dry cells. Before each observation, the platinum stimulating electrodes were applied to exposed skeletal muscle to verify the presence of a stimulus. The stimuli were varied in strength from minimal to maximal by changing the position of the secondary coil.

Records were taken in each experiment of changes in, (1) arterial blood pressure by a graphic method,[2] (2) respiratory activity and (3) serial electrocardiograms of Lead II. Control observations consisted of variations noted in these records, (1) before anesthesia, (2) after anesthesia was started and the patient put in a lateral position and (3) just before stimulation of the exposed celiac ganglion or other structures. These control observations were then compared with those made during or shortly after a ten to thirty second interval of faradic stimulation of the celiac ganglia. Each ganglion was stimulated at least twice. A total of twenty-two observations were completed. In some instances, the intact and the central end of the severed greater splanchnic nerves were stimulated.

In Table 1 is summarized briefly the average predominant changes noted upon faradic stimulation of the celiac ganglia in man.

It is readily seen that in each instance, the arterial blood pressure was increased varying from 18 to 56 mm. of mercury systolic blood pressure and from 0 to 32 mm. of mercury diastolic blood pressure. The degree of change depended largely upon the strength of stimulation employed. The systolic blood pressure elevation was more marked than the diastolic as is indi-

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cated by the increase in pulse pressure (11 to 38 mm. of mercury). The pulse pressure was never decreased. Changes in heart rate noted in the electrocardiogram were surprisingly variable but not marked. The heart rate increased in some and decreased in other experiments but were consistent for any one patient. Respirations were characterized by an immediate and transient apnea followed by a polypnea or occasionally a decrease in the rate of respiration. The apnea most commonly occurred in the inspiratory phase.

The intact greater splanchnic nerve and the central end of the severed nerve were stimulated with faradic current in each patient. In all instances, the elevation in blood and pulse pressure and extent of apnea were markedly augmented. The heart rate was generally unaffected. No fall in blood pressure occurred.

TABLE I

AVERAGE CHANGES IN CIRCULATORY AND RESPIRATORY RESPONSES NOTED FOLLOWING FARADIC STIMULATION OF THE CELIAC GANGLIA IN MAN

Cases Employed	Celiac Ganglion Stimulated	Blood Pressure mm. Hg.			Pulse Pressure mm. Hg.		Heart Rate (Ecg.)		Respiratory Rate per min.	
		Preop. Control	Before Stimul.	After Stimul.	Before Stimul.	After Stimul.	Before Stimul.	After Stimul.	Before Stimul.	After Stimul.
No. 1—F. D., male, 30, Dx: Hypertension with Cardio-vasc. Disease. Surg: Left coel. gang. removal with T11, L1, 2. (cyclopropane)	Left	170/100	184/90	235/120	94	115	66	88	20	Apnea
	Right	160/80	125/65	145/74	60	71	84	100	36	Apnea
No. 2—L. S., male, 55, Dx: Periph. Vasc. Dis. with Varic. Ulcers. Surg: Rt. Coel. Gang. & great. & lesser splanc. (N_2O-ether)	Right	116/70	140/68	158/70	72	93	78	90	30	14
No. 3—J. D., male, 56. Dx: Hypertension Surg: Left Coel. Gang. (N_2O-ether)	Left	126/70	135/75	182/84	60	98	78	90	36	Apnea
No. 4—S. H., male, 49. Dx: Hyperten. with c-v Dis. Surg: Rt. Coel. gang., great & lesser spl. nerves. (N_2O-ether)	Right	202/130	205/130	245/145	75	100	100	111	36	12
No. 5—A. R., male, 40. Dx: Hypertension Surg: Rt. Coel. gang. & splan. nerves.) (N_2O-ether)	Right	200/90	164/84	220/112	84	108	84	68	40	28
No. 6—R. E., male, 37, Dx: Hyper. with c-v Dis. Surg: Left Coel. gang. (N_2O-ether)	Left	250/170	205/144	238/164	61	74	102	110	30	Apnea

Examinations of serial electrocardiogram of Lead II taken simultaneously with blood pressure recordings and before and after faradic stimulation of the celiac ganglion revealed the following significant findings. These were noted in only five of twenty-two ganglionic stimulations. The changes in heart rate, as noted above, were consistent for any one patient and showed an in-

significant increase or decrease. However, arrhythmias were frequent, being of the sinus type or characterized by auricular or occasionally ventricular premature beats. Auricular-ventricular dissociation occurred twice. Split P waves and slurring of the R complex were also noted. An elevation of the S-T segment (3 mm.) was seen twice with the use of a strong faradic current. T waves were frequently inverted, widened and increased in height.

REMARKS

The upper abdominal viscera receive a dual autonomic nerve supply chiefly via the vagal nerve and the sympathetic fibers along the celiac plexus. The application of stimuli directly at the concentration of autonomic fibers at the celiac plexus is a logical procedure to use in determining the cardiovascular and respiratory effects from abdominal viscera stimulation as it may be observed during surgery. This approach has not been reported among the numerous experiments of various types of stimulations to abdominal organs in man. The results from stimulation of the celiac ganglion in animals have been studied.[1,3,4] This report concerns the results obtained following the direct stimulation of the celiac ganglia in man. The results obtained are not unlike those already reported from similar experiments completed on dogs.[1] Faradic stimulation of the celiac ganglion produced essentially a sympathomimetic response in the circulatory system. This was confirmed partly by obtaining a similar response upon stimulating the central cut end of the greater splanchnic nerve. There was a rise in systolic and diastolic blood pressure, in both man and dog. The elevations in blood pressure in the patients used in this study were not marked. This was probably due to the presence of a vascular disturbance with hypertension already present in some of the patients. Notwithstanding the close proximity of the vagal fibers in the region of the celiac plexus, bradycardia or other signs of vagal stimulation were seldom seen. Significant electrocardiographic changes were noted in only five of twenty-two experiments. However, it is presumed that some degree of vagal stimulation was manifest to account for the absence of tachycardia and of a decrease in pulse pressure and for the appearance of some of the electrocardiographic changes. While it is accepted that a dual autonomic innervation is normally balanced, it is quite probable that in the abdomen, the tonus of the sympathetic fibers is greater than that of the vagus and hence more susceptible to stimuli. In the thoracic region there is reason to believe that the reverse may be true. Thus, upon stimulation in the celiac plexus region, while both vagal and sympathetic fibers may be irritated, the effects from the latter predominate.

Significantly enough, no fall in blood pressure occurred in any of the patients upon stimulating the celiac ganglion, although such an effect occasionally was seen in the dog. It has been our clinical experience that manipulation of upper abdominal viscera under general anesthesia may produce a sudden reflex-like fall in arterial and pulse pressures with no significant change in heart rate.[5] In this instance, it is possible that stimulation of the abdominal vagus and its subsequent dromotropic as well as chronotropic effect upon the heart have overshadowed the influence of the sympathetic fibers. We have not yet been successful in obtaining an electrocardiogram at the time of such reflex vascular depression from visceral stimulation to fortify this contention. Another mechanism that may play a rôle here, may be a reflex vasodilator response involved by visceral afferent stimulation. The strength of stimulation determines the necessary threshold.

From a practical point of view, the treatment of vascular aberrations arising from direct celiac stimulation or following the manipulation of abdominal viscera is important. If an undue and dangerous hypertension results, it would seem logical either to remove the stimulus or block the nervous pathway. In the latter in-

stance, application of 1 per cent procaine solution over the celiac ganglion has been tried in several cases and found satisfactory. It is advised for all upper abdominal procedures in which a moderate or severe degree of manipulation of organs is anticipated. If a fall in blood pressure is seen associated with a decrease in pulse pressure and a slow pulse, vagal stimulation or the occurrence of a reflex vasodilator response may be assumed. To remedy this condition, the stimulus may be removed, procaine solution applied to the celiac plexus region or a vasoconstrictor such as ephedrine may be given.

The respiratory phenomenon resulting from faradic stimuli of the celiac ganglia in man are essentially similar to that found in the dog. The decrease in respiratory rate or frequently the occurrence of an apnea followed by a polypnea are the results of a strong reflex upon the respiratory center. These effects are short lived and are generally self-regulated by the chemical stimulation of accumulated carbon dioxide.

SUMMARY

During the course of surgery for vascular disturbances, the celiac ganglia in man were stimulated with a faradic induction coil and the responses noted in the circulatory and respiratory systems.

The changes were characterized by a rise in systolic and diastolic blood pressure, an increase in pulse pressure and a transient apnea followed by a polypnea. Electrocardiographic studies showed arrhythmias with occasional elevation of the S-T segment and widening and inversions of the T wave. The heart rate, *per se*, was not altered significantly.

The mechanisms involved and the clinical significance and treatment of these changes are discussed.

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Case Reports

FRACTURE OF THE LESSER TUBEROSITY OF THE HUMERUS

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FRACTURE of the lesser tuberosity of the humerus, unassociated with other fractures or with a dislocation of the shoulder joint is an infrequent injury. There are several reasons for the rarity of this lesion. From an anatomical standpoint, the lesser tuberosity is not very prominent and its position on the medial side of the head of the humerus is protected from direct injury. The subscapularis muscle has a very broad attachment to the lesser tuberosity and is inserted into the capsule of the shoulder joint, distributing its lines of force over a wide area with a short range of motion. The normal major function of the subscapularis muscle is to rotate the arm inward strongly and to adduct the arm when it is lifted about sixty degrees lateralward. The greatest force exerted by the subscapularis would occur

FIG. 1. Roentgenogram showing fracture of the lesser tuberosity. The fragment is rotated and displaced a greater distance than in the roentgenogram.

when a strong external rotatory and abduction force was applied at a time when the arm was in the position of maximum external rotation and about sixty degrees of lateralward abduction. It is apparent that this opportune combination of events would not be present very often, and because of the other anatomical factors the possibilities for a fracture or avulsion of the lesser tuberosity alone would be very small.

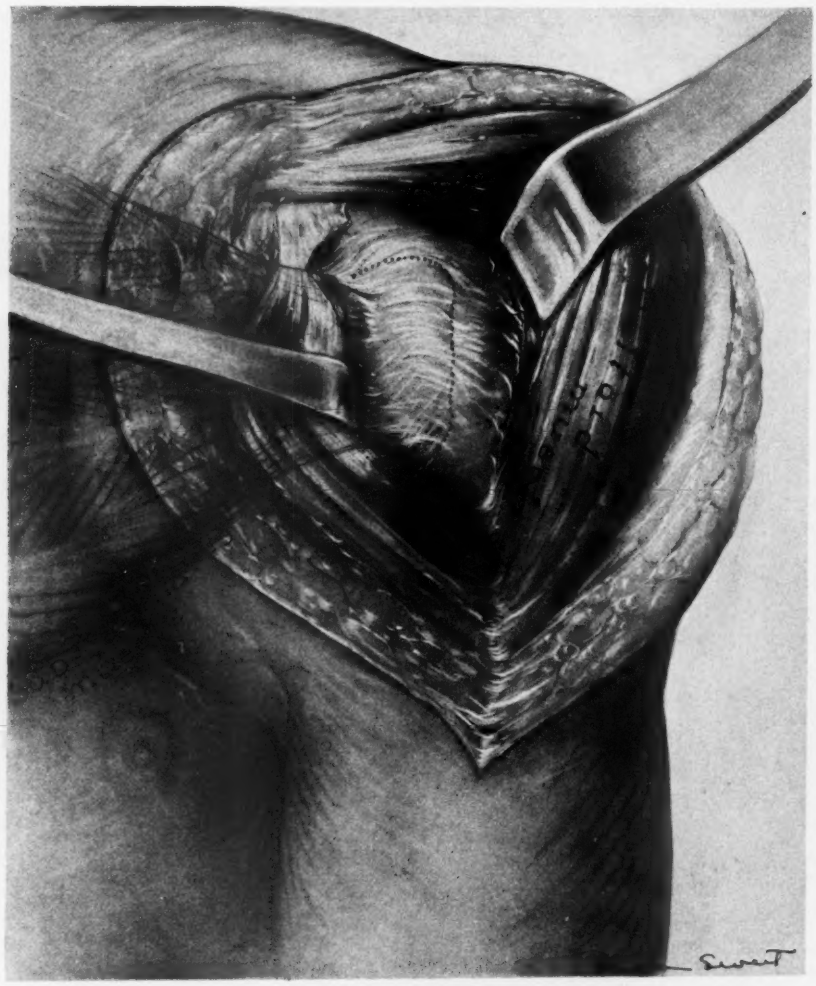

FIG. 2. Drawing shows approach to fracture of the lesser tuberosity of humerus. Notice cut through the short head of biceps to allow better exposure of fragment which will be pulled down and in by the subscapularis muscle.

We find very little data on methods of treatment for fracture of the lesser tuberosity and most authors pass it over with a few casual remarks. It is possible if the distraction is not too great that a manipulation of the arm in internal rotation and adduction will allow the fragment to approximate its position on the humerus and union will take place. Direct force cannot be applied to the fragment because of its deep seated position. If the fragment is not reduced, the strength of the involved upper extremity of the shoulder joint would be weakened. Furthermore, there is the possibility of restriction in motion and a painful shoulder due to impingement of the loose fragment on the rotating head. There may also be a tear of the capsule which may predispose for dislocation of the head of the humerus.

After considering all of these facts it is believed that operative interference is warranted, in any case in which the frag-

ment is not in close approximation to its normal position. The method of operation will be described in the report of a patient with a fracture of the lesser tuberosity.

FIG. 3. Roentgenogram two months after reduction. There is some calcification in the tendon of the subscapularis muscle.

CASE REPORT

The patient, W. T., a white male, age thirty-three, was referred by Dr. George Cox. He gave a history of having fallen on April 9, 1942, while descending a flight of stairs. He did not know the position of his arm when he struck the floor. There was considerable pain and swelling in the region of the shoulder joint. The roentgenogram revealed a fracture of the lesser tuberosity and the fracture surface was rotated away from its normal position. (Fig. 1.) When seen the next day, the swelling had increased. The arm was held to the side, abduction was resisted and painful when forced. Internal rotation was fairly free and only slightly painful, but external rotation was quite painful and restricted. Several attempts were made to reduce the fracture but were unsuccessful, after which, operation was decided upon.

Operation was performed on April 15, 1942, under a general anesthetic. An incision was made along the outer end of the clavicle curving down along the inner margin of the deltoid muscle. The approach was quite similar to that of Sever's for release of the subscapularis muscle in obstetrical paralysis, but a little wider exposure was utilized. The dissection was carried down through the fat and fascia to the margin of the deltoid muscle which was then underminded and retracted lateralward. (Fig. 2.) The coracoid process of the scapula was located and the short head of the biceps and coracobrachialis insertions were exposed. The tendon of the short head of the biceps muscle was severed below the coracoid process. A considerable mass of clotted blood in the underlying tissue was removed and the dissection carried

downward and inward until the fragment of the lesser tuberosity was located. The fragment was turned over on itself and was pulled down and inward by the contracted subscapularis muscle. The bed from which the fragment was torn on the humerus was then exposed, and in the immediate vicinity a hole in the capsule of the shoulder joint was found. The torn fragment was reduced and placed in its normal position. Two holes were bored through the torn off piece of bone and two holes in the humerus, after which heavy silk sutures were passed through the corresponding holes in the fragment and humerus, fixing the fragment in its normal relation to the head of the humerus. Supplementary sutures were placed extending from the subscapularis tendon to the capsule. The tear in the capsule of the shoulder joint was closed with heavy silk sutures. These latter sutures came close to the bicipital groove, but care was taken not to include the tendon of the long head of the biceps. The severed section of the short head of the biceps was sutured with silk and the wound closed with chromic catgut for the deep layer and silk for the skin. The arm was placed in internal rotation and adduction and fixed in place with a Valpeau type of bandage.

On April 27th, twelve days after the operation the arm was placed in a sling, but at night an additional circular bandage was applied about the chest. Gentle daily abduction exercises were started with gradual increase in range of motion. Later external rotation was instituted, being quite guarded up to the sixth week. Heat therapy, stretching, passive and active movements were applied and there was a gradual increase in strength of the muscles and range of motion at the shoulder joint. The last few degrees of external rotation were the most stubborn to overcome. The patient ultimately attained a full range of motion with normal strength, and subsequently he passed the physical examination for the Ski Troop. (Figs. 4 and 5.)

Fig. 4. Range of abduction and external rotation.

Fig. 5. Range of internal rotation.

CONCLUSION

Fracture of the lesser tuberosity by itself is an infrequent injury. Operative restoration is the method of choice in order to obtain a full painless range of motion with normal strength of muscle control.

ECTOPIC PREGNANCY

GESTATION OF EIGHT MONTHS—RETAINED EIGHT YEARS

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FROM the opening paragraph of that excellent monograph, "Extra-Uterine Pregnancy," by Dr. Edward A. Schumann we read as follows: "The history of the recognition of pregnancy proceeding outside the cavity of the uterus, the gradual understanding of its gravity and the development of modern methods of its treatment, forms one of the most fascinating episodes in that epitome of human intellect, its brilliancies and its lamentable failures, the history of medicine."

CASE REPORT

A colored woman about forty years of age expected to be delivered in August, 1935. She had had cessation of menses, abdominal enlargement, and had felt fetal movement. Progress had seemed normal. In August, 1935, however, movements had ceased and soon afterward she began to menstruate regularly but too freely. In February, 1936, she was seen by one of us (H. L. D.). Her abdominal tumor was noted to be the size of full gestation but there was no movement and no sounds were heard. Pelvic examination showed a chronic cervicitis with no dilatation or softening. She was considered to have a dead pregnancy or a fibroid tumor or both. She was advised to have a laparotomy as the safest method of delivery. Her family agreed and she promised to return the following week but failed to do so.

She was next seen in March, 1943, under a different name, referred by a different family physician, and for another condition. There was, therefore, a lapse of several days before the two admissions were found to be of the same person. At the time of the more recent admission she presented a typical picture of partial high intestinal obstruction of five days' duration. There was soft distention in the upper abdomen but a hard, somewhat irregular tumor, estimated to be the size of a seven or eight months' pregnancy, arose in the lower left quadrant. She told us that we had advised her to have a "tumor" removed in 1936 but she had gotten on so well, being able to work every day, that she had failed to return. The tumor had not increased in size, and no periods had been missed until one month ago, and to this she gave no significance. It was only when the family was called in for consultation that connection between this and the previous admission was established. Use of Wangensteen suction, intravenous fluids, and mild sedation gave temporary relief for forty-eight hours prior to laparotomy.

The tumor was ovoid and appeared to arise from the region of the left broad ligament. It shelled away with fair ease from the anterior wall. There were numerous points of attachment of the small bowel to the tumor, one of which was definitely constricted. These attachments were freed with little damage to the bowel. Adhesions were freed to a very narrow base. The left tube could not be identified and no left ovary was found. As the pedicle of the tumor was well away from the uterine fundus we considered the tumor as arising from the left ovary. The leathery coating was impregnated at numerous points with calcium deposits.

Within the membranous envelope we found a fetus of an estimated eight months' gestation tightly compressed and molded on itself. Its outside surface and the inside surface of the sac were dry and waxy, separating readily. There was a thin, evenly distributed layer of short soft black hair between the fetus and the sac. The dried up cord ran to placental remains firmly attached within the sac. The fetal soft parts while very dry were not calcified.

COMMENT

Kuchenmeister, in 1881, designed a classification of retained extrauterine pregnancies which clarifies the subject enormously. The first type is best illustrated by

our own case which he would call a *litho-kelyphos* since the calcification was limited to the membranes or the fetal sac. He suggests that the sac sets up a low grade irritative peritonitis giving rise to a fibrinous exudate covering the walls of the sac and eventually undergoing calcareous degeneration. His second type he terms *lithokelyphopedion* and applies this name when both membranes and sac are involved in the calcareous process. The third type is the true *lithopedion* in which the fetal body is chiefly affected. Here the membranes are less definitely differentiated and removal entails greater trauma to the peritonealized structures to which they are attached. One of us (W. C. H.) had the pleasure of watching the late Dr. A. Murat Willis, of Richmond, Virginia, remove a true lithopedion from the abdominal cavity of a colored woman where it had remained for sixteen years. On contact with outside air layers of calcified material dropped away from the body of the fetus.

For those who are interested in the historical aspects of this class of cases we would suggest the monograph of Schumann referred to above. Beginning with the case observed by Albucasis about the middle of the eleventh century and recorded by Francisco Rousetti he shows how the earliest cases were diagnosed only when they ulcerated through the abdominal wall. Jacob Nufer's abdominal section on his own wife in 1500 and recorded as the classical first case of cesarean section suggests the possibility of abdominal pregnancy. It was stated, "He opened the abdomen so cleverly at the first incision that the child was safely extracted." Only in 1594 did Primrose deliberately remove the first recognized abdominal pregnancy.

Progress was made with time as indicated by the report in 1913 by Dr. J. Shelton Horsley who, following a case of his own, had records of 138 extrauterine pregnancies with living child at or near term. Lash noted pre-eclampsia with an abdominal pregnancy.

Human frailty looms large in the picture, however. As with us, so with others, patients do not always follow our advice and with the years comes calcium. Otell, in Washington, D. C. records a case of a retained fetus of forty years' duration removed at autopsy in a woman of seventy-five who died of other causes. Titus and Eisaman, of Pittsburgh, present a beautiful diagnostic study of a fetus retained for forty years. DeLee stated that "Wagner had a case where a mummified fetus was carried for 29 years and Virchow one for 28 years. Smith describes a calcified fetus which was removed from a woman 94 years old, 60 years after conception." Cullen had one at Johns Hopkins retained three years, Hayd's case was of thirty-three years' duration, and others of similar durations.

We present our case to add to the statistical study of a rather unusual condition.

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HERNIAS

REPORT OF TWO UNUSUAL CASES

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PATIENTS with hernias are being hospitalized in large numbers on all surgical services associated with preparing our men for the present emergency. The increased frequency of these patients affords most hospitals the opportunity to have much variation in the types treated. This report presents two cases of unusual hernias, namely, left superficial interparietal inguinal hernia, and bilateral direct inguinal and femoral hernias.

An interparietal inguinal hernia is an uncommon type located in the inguinal region lying between layers of the abdominal wall. Fuld,[1] and Lower and Hicken[2] have anatomically classified them as follows: (1) Properitoneal inguinal hernia; the sac lies between the transversalis fascia and the peritoneum; (2) interstitial inguinal hernia, the sac lies between two abdominal muscles; and (3) superficial inguinal hernia; the sac lies between the aponeurosis of the external oblique muscle and the integument. Statistics are not available giving the incidence of these hernias.

The following case illustrates the superficial variety of interparietal inguinal hernia with the sac being located between Camper's and Scarpa's fascias.

CASE REPORT

CASE 1. A. S. H. No. 18472, a twenty-six year old, white soldier was admitted June 24, 1942, with an atraumatic history of a mass the size of a lemon in the left lower quadrant of three months' duration. The lump usually made its appearance while he was walking and generally disappeared on lying down. At irregular intervals the enlargement was tender but on the admission date this symptom was more pronounced than usual, causing him to seek medical attention. The patient had always had an undescended left testicle.

Physical examination revealed a moderately well developed and nourished white soldier in no apparent acute pain with a mass in the left inguinal region the size of a large lemon. The disorder was above Poupart's ligament opposite and above the external inguinal ring which admitted the index finger with slight difficulty. The hernia was tense, slightly fluctuant, moderately tender and non-reducible.

Immediate surgery was thought advisable and at operation a hernia was found that had dissected itself upward from the external inguinal ring between Camper's and Scarpa's fascias for a distance of two inches. The hernial sac contained incarcerated omentum, testicle, and fluid, all of which were released when the external oblique fascia was separated down to the external inguinal ring. A moderate varicocele accompanied the spermatic cord involving largely the posterior vein group. Two-thirds of the varicocele was removed and the hernial sac excised at its neck after placing a purse-string suture. The distal portion of the sac was sutured about the testicle performing a "bottle operation." Preoperatively the soldier had repeatedly requested that his testicle not be removed so it was placed and fixed just below the os pubis in the upper scrotum after reconstructing a new floor for the spermatic cord with the conjoined tendon and Poupart's ligament. Slight lengthening of the cord had been obtained by the varicocelectomy and the vas deferens was partially mobilized in a manner similar to that described by Brunkow.[3] The external oblique fascia was closed over the cord structures.

The postoperative course was uneventful with the soldier being discharged in thirty days and he was performing his military duties satisfactorily with no complaints four months later.

The incidence of both inguinal and femoral hernias in the same patient is

infrequent. Jason[4] lists in his series one case of bilateral indirect inguinal and femoral hernias and two cases of right (not classified) inguinal and femoral hernias. Annandale[5] reported a case of reducible unilateral indirect and direct inguinal and femoral hernias.

Case II. V. L. W. No. 29336, a twenty-six year old, white soldier was admitted January 14, 1943, with an atraumatic history of vague pain in the right lower quadrant for six years. He was hospitalized for elective correction of his hernias.

Physical examination revealed a moderately well developed and nourished white soldier in no distress with right complete inguinal and femoral hernias and left incomplete inguinal and femoral hernias.

A three-inch, curved incision was made beginning above and parallel to the right Poupart's ligament curving downward over the femoral ring. The direct hernial sac had a base one and one-half inches wide and protruded the same distance. This sac was opened and by blunt dissection the femoral sac, measuring one inch by one inch, was peeled into the direct sac which was purse stringed at its base. The stump was fixed beneath the right internal oblique muscle. The femoral ring was narrowed by placing interrupted sutures between Poupart's ligament and pectineus muscle and fascia. The direct portion of the hernia was repaired by suturing the conjoined tendon to Poupart's ligament and closing the external oblique fascia over the cord.

The soldier was discharged to duty after thirty days of uneventful convalescence, returning one month (two months postoperatively) later with an acute right epididymitis but it seemed rather late for a complication of this type to follow his surgery. For the past four weeks the soldier has been performing full military duty, being free of all symptoms.

The left inguinal and femoral hernias have not been operated upon because they are incomplete and asymptomatic.

SUMMARY

Two cases of unusual hernias, namely, left superficial interparietal inguinal hernia and bilateral direct inguinal and femoral hernias are reported.

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PERMANENT URINARY CONTINENCE FOLLOWING PELVIC SURGERY*

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POSTOPERATIVE anatomical lesions rarely present a basis for analysis of the etiology for complete urinary incontinence. The bizarre pathological picture found in a patient with this condition is so striking and etiologically problematical that it seems worthy of discussion and recording. Furthermore, it may suggest an additional causative factor for urinary continence pending further experimental proof or clinical evidence.

Urinary retention, while not a clinical rarity, may be attributable to various specific causes. Generally this phenomenon is due either to mechanical obstruction, functional or pathological neurogenous changes or genitourinary tract trauma. Intravesical or urethral neoplasms, anatomical changes, diverticuli as well as extravesical tumors impinging upon the vesico-urethral junction may obstruct urinary flow. Pathological and functional diseases altering the continuity of the cerebrospinal or peripheral arc pathways destroy the micturition reflex and give rise to the "cord" or neurogenic bladder, commonly exemplified in syphilis and diabetes. Concussion, surgical shock, spinal and caudal anesthesias, severe neuroses, prolonged febrile states and cord anomolies, as found with spina bifida, are among the common neurological entities also causing this condition. Urinary tract trauma, incidental to surgery, gravidity, radiation and instrumentation not infrequently precede the cessation of urinary flow.

What rôle the mechanical factor inherent in vesico-urethral angulation and distortion plays in urinary blockage is a moot question which arises in this case. Anatomically and embryologically, the urinary and genital systems are closely linked. The marked alterations of the former, some, in fact, physiological, which are induced by gravidity, large uterine neoplasms and pelvic inflammatory masses are well recognized. Incidental to these conditions, the increased vesico-urethral angulation and the associated dislocation of the fixed vesical floor present a definite mechanical basis for urine retention. The degree of increased angulation, however, requisite for complete urinary continence is uncertain.

In this patient, a nullipara, a large posterior enterocele, a small cystorectocele, marked urethral eversion, and an occult spina bifida were found in combination with an upwardly displaced uterus, markedly elevated and fixed in the false pelvis, and a bladder, retracted and adherent to the anterior abdominal peritoneum.

The patient, M. A., age thirty years, married seven years, nulligravida (husband had gonorrhea in 1926. Kahn test negative). Menses were normal in all respects. There was no history of dysmenorrhea.

She had whooping cough, measles, scarlet fever and occasional "head colds." After the first year of married life, she frequently experienced lower abdominal pains and in March, 1941, a "chronic appendix and a follicular cyst of the left ovary" (pathological report) were removed at the Union Hospital in Fall River, Massachusetts. One ampule of amniotic fluid was injected into the pelvis after dense adhesions were separated.

Immediately following operation, urgency, dysuria, and a progressively increasing tenesmus occurred and, during convalescence at home, she developed a profound anxiety state and insomnia on account of a complete urinary continence with severe suprapubic pain and swelling.

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To overcome the obstruction, a "urethral caruncle" was chemically cauterized and, several times subsequently, Nos. 18 and 20 bougies F. were passed. Under spinal anesthesia, at a later date, cystoscopy and retrograde pyelography were twice performed by different urologists, who reported "many inflammatory papillary projections encroaching upon the bladder lumen. Outline and function of the urinary tracts were normal." The obstruction was resected and again reported microscopically as "caruncle."

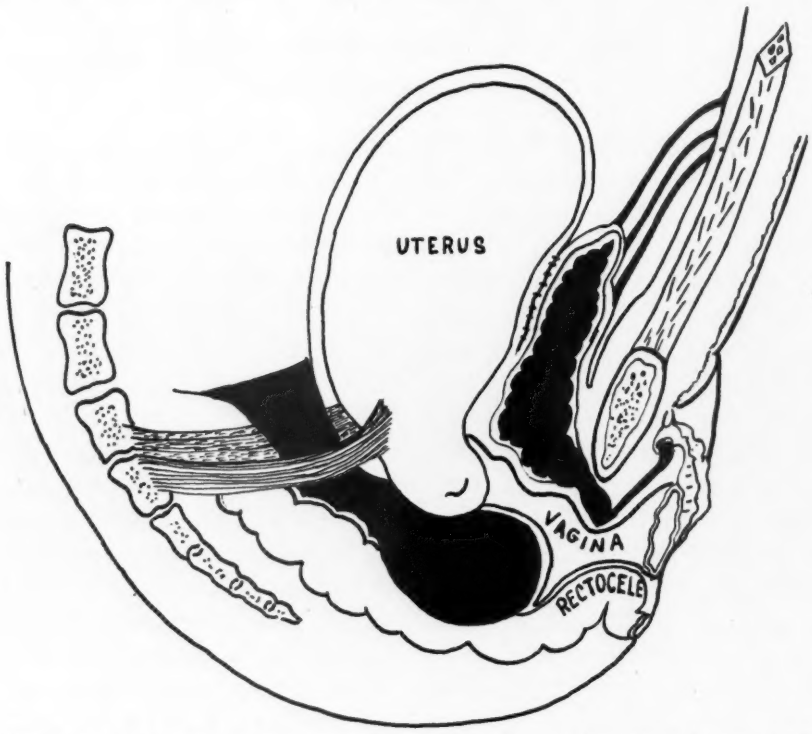

FIG. 1. Ink drawing indicating (in heavy black wash) enterocele, urethral angulation and eversion, high vesicoperitoneal adhesions and elevated vesico-uterine level.

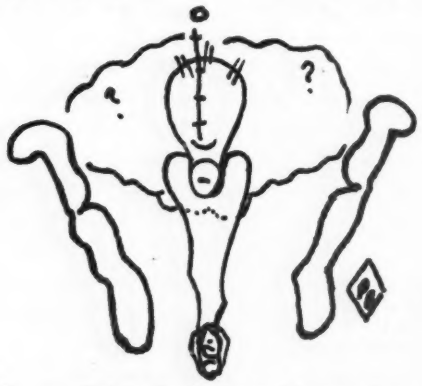

FIG. 2. Pelvic findings on bimanual examinations: ink sketch showing a high, vaguely outlined fundus, confluent with a cystic resistance which completely filled the pelvis, thus elevating vesico-uterine structures.

Still unrelieved, and upon the advice of a midwife, the patient resorted to self-catheterization in squatting position, twice daily, over a period of four months. For the past three weeks, a vaginal "lump" was felt upon exertion or standing.

I examined her for the first time on January 6, 1942; the following physical findings were apparent: She was a well nourished, nervous female, with erect posture and regular body proportions. There were no surface stigmas of disease. Head, neck and chest were well developed, breasts fully matured, heart and lungs were normal. Blood pressure was 118/80. Abdominal examination revealed nothing unusual except a well healed, midline suprapubic scar. Inguinal areas were intact. Superficial and deep reflexes of abdominal wall and extremities were equal and active. Special senses, pupillary and cranial reflexes were within normal range. There were no signs of cerebrospinal syphilis and no saddle anesthesia.

The pelvic examination revealed these significant facts: A nulliparous intact introitus;

relaxed and flaccid perineum; a small asymptomatic cystorectocele; no urethrocele. Upon straining, the urethra rotated forward, outward and upward in a 90° arc, completely everted from its subpubic position. (Fig. 1.)

Fig. 3. *X*-ray indicating spina bifida (arrow).

A posterior vaginal wall enterocele bulged forward voluminously on pressure into the spacious posterior fornix, riding downward over the rectocele eminence. Upon reduction, a gurgling sound was elicited.

The nulliparous cervix was retracted and fixed high up behind the pubis, obliterating the anterior fornix. Pubocervical area felt firm. The fundus, vaguely outlined, seemed ventrofixed about two fingers above the symphysis pubis and confluent with a soft resistance palpable throughout the entire pelvis. (Fig. 2.) The adnexae were not distinguished.

X-ray of the lumbosacral spine showed: "Failure of complete fusion of posterior arc of first sacral segment constituting spina bifida occulta of 4th lumbar vertebra." (Fig. 3.) Intravenous pyelography was not remarkable. Kidney, pelvis and ureteral markings and function were normal on both sides. Blood studies: 5,200,000 red blood cells; 82 per cent hemoglobin; 8,800 white blood cells, 78 per cent polymorphonuclear leucocytes; 14 per cent lymphocytes; 5 per cent monocytes; 3 per cent eosinophiles. The catheterized specimen showed specific gravity, 1012; no casts, albumen or sugar, few red blood cells and pus cells and no clumps. The Kahn test of spinal fluid and blood were both negative.

A vaginal repair was advised and also laparotomy, if warranted by pelvic examination under anesthesia. Loss of childbearing function and castration effects incidental to an anticipated complete extirpation were outlined.

On January 16, 1942, under gas-oxygen-ether anesthesia, at the Newport Hospital, Newport, R. I., the pelvic examination confirmed the previous findings.

Following a dilatation and curettage, an anterior colporrhaphy and Kelly urethroplasty were performed with permanent catheter inserted into bladder. (Fig. 4.) The new urethral floor was reinforced by two interrupted No. 2 chromic sutures which incorporated the periosteal tissue overlying the inner margin of the pubic rami. A firm support and urethral fixation were thus completed.

The enterocele exposure required a high triangular mucosal denudation of the posterior

vaginal wall. (Fig. 5.) The sac was separated bluntly from its rectovaginal attachments and was opened, amputated and fixed high up by

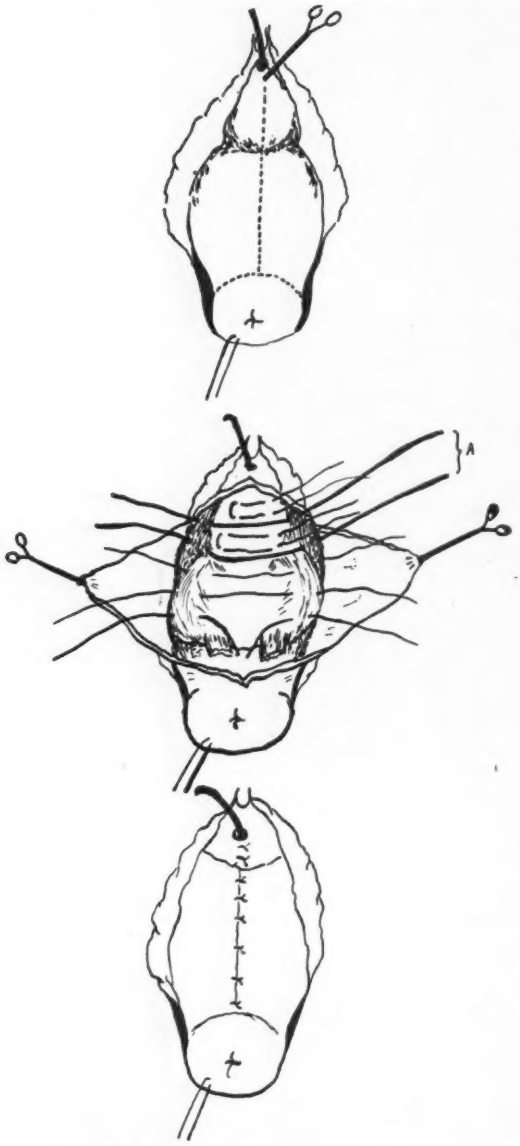

FIG. 4. Ink sketches showing urethrocystocele repair; mucosal incision, periosteal (A), and Kelly sutures in urethral area; bladder and cervical fixation sutures; and mucosal approximation. Permanent catherer *in situ*.

a purse-string suture, into the posterior cervix. Obliteration of the retrocervical hernial hiatus was accomplished by several interrupted sutures approximating prerectal fascia to cervix. Levatores ani, deep and superficial perinei muscles were then used to roof the rectocele, forming a moderately high perineum and a three finger introitus.

Through the suprapubic abdominal opening, view of the pelvic structures was completely obliterated by a coalescent mass of variably sized seroceles and adhesions into which the sigmoid disappeared. (Fig. 6.) The bladder, uterus and adnexae were identified after decompression of these cysts, which reached deep into the cul-de-sac and pelvic floor, thus elevating the fundus and bladder to the suprapubic level (Fig. 1) and accounting for the "fixation" of the uterus. The anterior cul-de-sac was obliterated by thickened pubovesical ligaments, adhesions of pubovesical peritoneum and small cysts. Extirpation of the adherent adnexal inflammatory masses necessitated almost complete pelvic floor denudation.

A typical double clamp and double ligature supravaginal hysterectomy and bilateral salpingo-oophorectomy was performed. The sigmoid was used to complete the friable peritonealization. Continuous No. 2 chromic sutures were used for the peritoneal closure and continuous interrupted sutures for the fascia. Heavy silk retention sutures were employed. No drainage was used.

The pathological diagnosis was, "Chronic endometritis, chronic salpingitis with fibrosis and chronic oophoritis with hemorrhagic corpus luteum of both ovaries."

The postoperative course was undisturbed except for mild flushes and sweats, which disappeared after oral administration of 0.5 mg. of stilbesterol daily. On the eighth day, the indwelling catheter was removed. After voiding, bladder retention was less than 50 cc. She was discharged on the fourteenth postoperative day.

Follow-up examinations on April 25th and October 10, 1942, revealed no urethral eversion on straining. The urethral floor was dense and firm and introitus ample. The perineum was moderately high. The posterior and anterior vaginal walls remain up on straining. There was no enterocele. The fornices were soft, cervical stump movable and high, vaginal depth normal and no tenesmus. Menopause symptoms persisted but were well controlled by stilbesterol. The patient felt very well and had resumed work. There were no urinary symptoms; continence was cured.

COMMENT

In nulliparous women a spina bifida may be the cause of weakness or hernia of the

pelvic floor. This congenital closure defect of the spine may be accompanied by varying degrees of atrophy in nerves supplying the pelvic musculature. Under conditions of strain or the use of force, such as observed in uterine contractions, fecal or urinary tenesmus, lifting or overexertion, the atonic pelvic floor may give way, producing a procidentia of pelvic structures.

Briefly resumed, the onset of urinary continence in this patient occurred while still in the hospital after the operation (March, 1941), in which pelvic adhesions were separated and one ampule of amniotic fluid was injected. Our laparotomy findings, namely, the diffuse pelvic serocele inflammation and the upward retraction of the bladder and uterus, it is reasonable to assume, began to develop during this interval as manifested by postoperative onset and bladder symptoms.

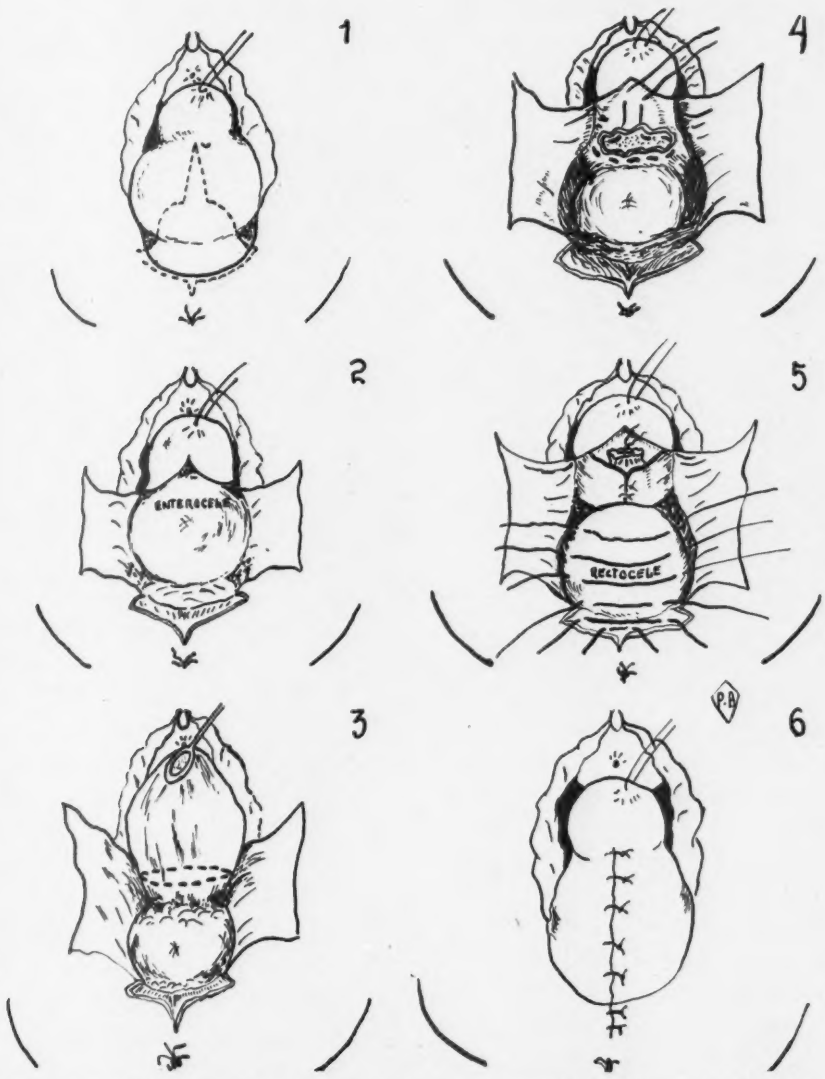

Fig. 5. Ink sketches depicting steps in posterior vaginal wall repair; (1) high triangular mucosal denudation; (2) exposure; (3) separation; (4) purse-string ligation; (5) cervical fixation of enterocele sac with closure of extravesical hernial orifice, rectocele repair, and (6) perineal and mucosal closure.

The acute vesico-urethral narrowing, attenuation and compression was due to the traction of the completely everted urethra (produced by tenesmus associated with

urethral structure weakness incidental to congenital spina bifida) upon the retracted and adherent bladder fundus (due to amniotic fluid? and adhesions). Manifestations of hernia (enterocele) and increased pelvic floor weakness (urethral eversion and moderate cystorectocele) resulted from the marked tenesmus during the postoperative period.

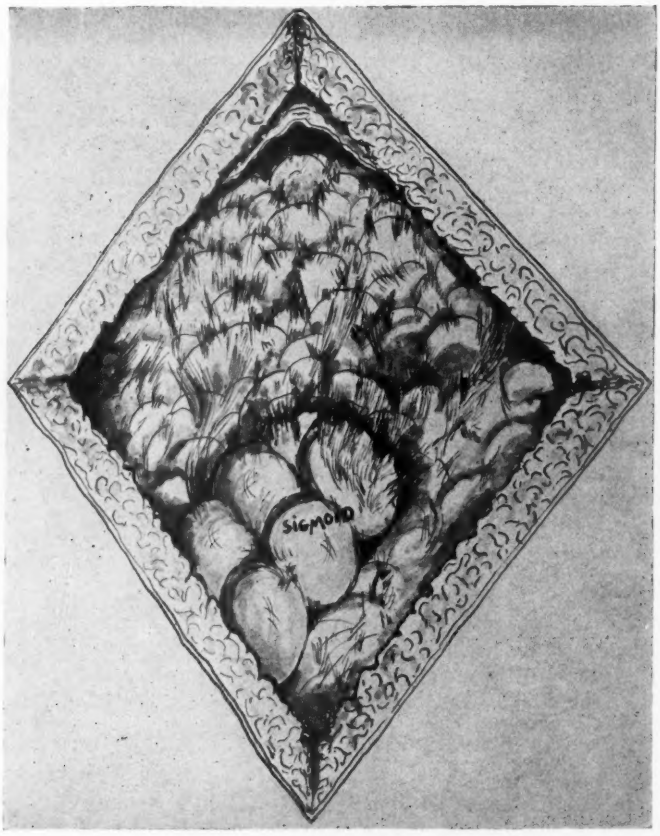

FIG. 6. Ink drawing of pelvis through laparotomy opening; note complete obliteration of genitalia and terminal colon by diffuse serocele formation and adhesions.

The explanation of complete urinary continence, based upon the pelvic and vaginal findings in this patient, would seem to depend upon four anatomico-mechanical factors directly involving the vesico-urethral junction: (1) acute angulation, (2) eversion, (3) fixed pressure from the symphysis pubis and (4) the traction exerted upon this area by the urethral eversion counteracting the high vesical fixation.

During micturition, the active forces applied to the bladder neck are (1) outward traction by the everting urethra, (2) upward traction exercised by the fixed bladder, and (3) the downward pressure exerted by the bony symphysis against the vesico-urethral junction.

CONCLUSION

The problem of bladder dysfunction has interested gynecologists for a long time.

This analysis of the dynamics, the neurological and anatomical features of urinary dysfunction presents clinical evidence of an additional cause for bladder incompetency, namely, vesico-urethral angulation caused by opponent forces of traction and pressure, due to postoperative pelvic adhesions and pelvic floor weakness and hernia.

While permanent urinary continence such as found in this patient is in itself rare, the factors taking part in its mechanism are probably identical with those of its more frequent counterpart, urinary incontinence, the absolute causes and cure of which are still uncertain. For this reason, the information derived from this study may be of some value.

RIGHT TRAUMATIC DIAPHRAGMATIC HERNIA

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HERNIATION of the abdominal viscera into the right hemothorax is unusual. This case represents very many interesting things:

The patient was a white male, age 35, who had had an automobile accident eleven years before. At that time he had suffered a fracture of his spine and had a laceration of his diaphragm, but he had recovered from this serious accident and had carried on fairly satisfactorily for a period of eleven years. Recently, however, there have been attacks of abdominal pain, crampy in nature, associated with nausea and vomiting which led one to believe that he probably had an intermittent intestinal obstruction. He had known that he had had a diaphragmatic hernia on the right side since the time of his injury.

X-rays revealed a separation of the diaphragm from the anterior chest wall through which protruded the ascending colon, stomach, cecum, appendix and loops of ileum. His general condition was quite normal. Operation was advised and because of the anterior location of the rent in the diaphragm, an anterior abdominal approach was decided upon. Under intratracheal anesthesia a high right rectus incision was made, and it was found that the right leaf of the diaphragm had been torn from the chest wall, starting at the xiphoid and extending well around to the mid-axillary line. The diaphragm just dropped posteriorly.

FIG. 1. Numerous loops of small intestine are seen in the right lower chest cavity. The outline of the diaphragm is not visualized.

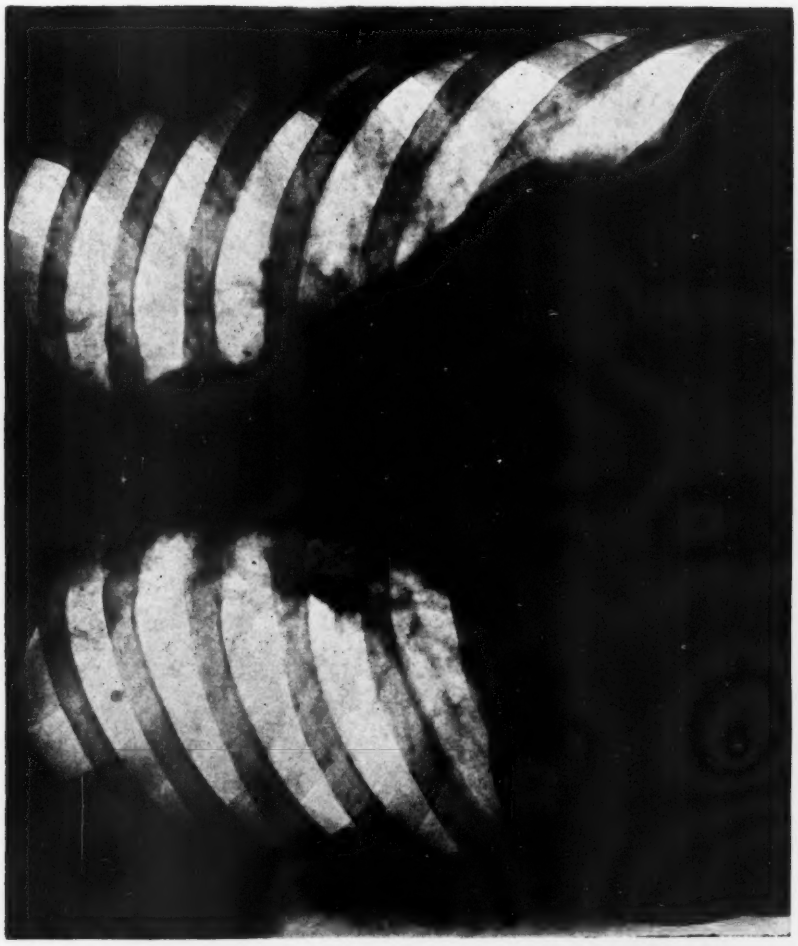

Fig. 3. Shows the lung completely re-expanded on the thirty-sixth postoperative day. Outline of the diaphragm was well visualized.

Fig. 2. Barium filled colon shows the entire right colon and most of the transverse colon with loops of small intestine extending into the right hemothorax.

Through this opening the transverse colon, ascending colon, ileum and stomach herniated into the chest cavity as high as the apex of the chest. The lung was about two-thirds compressed. The round ligament and falciform ligament of the liver had been completely torn, so that the left lobe of the liver was lying in the right lower quadrant, the liver having rotated into this position. When the liver dropped down, of course, this enabled the other abdominal viscera to get through the opening readily in the diaphragm. The abdominal viscera could readily be replaced in the abdominal cavity with the exception of the duodenum, which was adhered along the mediastinum. This was separated and replaced. The diaphragm was then resutured to the anterior chest wall, using catgut and fascia lata stitches.

Fig. 4. The thirty-sixth postoperative day shows the barium filled colon and stomach well below the diaphragm.

The liver was replaced in its normal position and sutured up over the rent to act as a buffer. The falciform and round ligaments were reconstructed. The procedure worked out very well. The abdomen and chest were closed without drainage.

The patient stood the operation well and had, with the exception of an accumulation of some fluid under the skin flap, almost an uneventful convalescence. *X*-ray of his chest and abdominal viscera three weeks after operation revealed the viscera to be in normal relation in

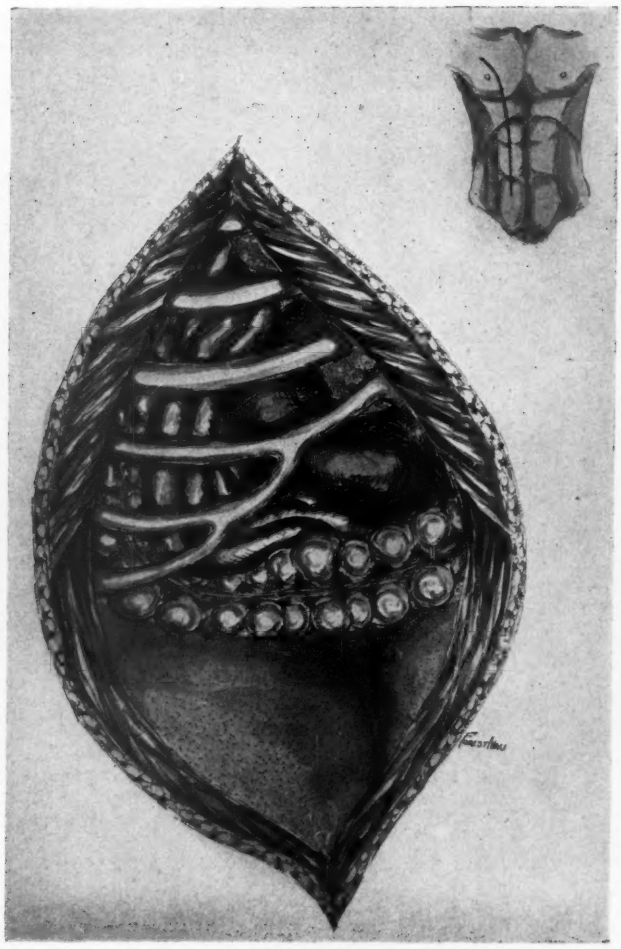

FIG. 5. The type of incision utilized and the position of the abdominal viscera in the right chest cavity.

the abdomen. He is eating well and his general condition is excellent.

This is the second traumatic diaphragmatic rupture that I have repaired within the year. The other occurred on the left side, and was a laceration of the dome, through which the spleen, transverse colon and loops of small bowel were herniated into the left chest cavity. This laceration was repaired by transcostal approach, suturing the diaphragm from above.

Each case is an individual one and the type of incision for exposure will depend upon the location.

Fig. 6. The method of suture of the diaphragm to the chest wall by through-and-through suture is shown.

POSTPARTUM HEMATOMAS

REPORT OF FOUR CASES

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THE subject of postpartum vulvar and paravaginal hematomas has evinced only passing interest among students and practitioners of obstetrics. This hemorrhage into the soft tissues surrounding the birth canal may be so extensive as to cause severe shock, and if unrecognized or improperly treated, may even result in death. The literature on this subject is relatively meager, although one notes occasional references to it. Hamilton[1] was able to collect only 156 cases of postpartum hematomas up to 1940 and added twelve cases of his own to this number.

Reuff,[2] in 1554, gave the first description of the vulvar and perineal types. Baudelocque[3] first diagnosed the subperitoneal variety following labor, and Casaubon[4] reported it in the literature in 1797. Williams,[5] in 1904, collected thirty-four cases of the latter type and reported a case of his own following labor, not associated with lesions of the uterus. DeLee[6] reported an incidence of hematomas of any variety as one in about 4,000 labors. He noted the fact that large hematomas are rare, but that the smaller ones are seen much more frequently, especially when repairing a torn perineum.

Hematomas occurring in and about the birth canal in the parturient may be divided into the immediate and delayed types. The former occurs immediately and may follow spontaneous or operative delivery. The latter occurs later and is due to sloughing of a vessel, usually a vein which has become necrotic as a result of prolonged pressure.

The delayed cases have been known to occur as late as three weeks postpartum. If the hemorrhage occurs external to the pelvic fascia and levator ani muscles, the perineum becomes distended by the dissecting mass and swelling of the vulval area, usually on one side, will be noted. If the bleeding takes place above the pelvic fascia and levators, or at the base of the broad ligaments, it may extend up into the false pelvis under Poupart's ligament, or even subperitoneally to the kidney and diaphragm. Too vigorous massage of the uterus may result in hematomas in the subperitoneal connective tissue and in the broad ligaments.[7] Toxemias of pregnancy have been thought to be a causative factor of the bleeding tendency, but hematomas have been encountered in normal, spontaneous births in which labor has not been prolonged and there has been no evidence of toxemia. The blood extravasates along the lines of cleavage of the muscles and fascia.[8]

Vulvar hematomas usually appear within a few hours after the completion of delivery. The blood is extravasated before the end of labor and in most cases accumulates as a mass shortly thereafter. In the immediate variety the mass is usually well formed within six to ten hours and, as a rule, is limited to one labium majus. Rarely, the blood mass may appear late in pregnancy or during labor and thus interfere with the descent of the presenting part. In this situation it has been mistaken for a fetal head or placenta prævia.[9]

Intense pain is the most prominent symptom if the bleeding occurs around the rectum and bladder, but in other cases, signs of acute blood loss or anemia arouse the obstetrician's suspicion. Inspection of the vulva will reveal a tense, elastic, fluctuating, painful mass covered by a bluish, discolored skin. If no external mass is

found, vaginal examination will disclose a swelling in the paravaginal tissues. The tumor mass may even occupy the ischiorectal fossa and buttock. In the subperitoneal variety, it may be felt between the layers of the broad ligament. Edgar[10] states that in twins a hematoma may follow the birth of the first child and constitute an obstacle to the passage of the second twin.

As soon as the diagnosis is made, active treatment is indicated. If left alone, the patient may succumb to shock from the loss of blood, or to septicemia from the breaking down of the tumor mass with abscess formation. The mass should be opened widely, preferably through the vaginal mucosa, and all clots evacuated. Bleeding points, if found, must be ligated. The cavity is then packed with gauze and counter-pressure obtained by packing the vagina tightly. A T binder may then be applied for compression. Meanwhile supportive measures, such as transfusion of whole blood or blood substitutes, should be promptly instituted.

Prophylactic therapy consists in the proper treatment of the toxemias of pregnancy, as some observers think that a relationship exists between toxemia and postpartum hematomas. Blood dyscrasias or bleeding tendencies should be treated with calcium, vitamin K or small blood transfusions, if necessary. The vulva and vaginal tract should be inspected postpartum for tears and bleeding points, especially at the upper angle of lacerations and episiotomies. An insignificant ooze in this location may terminate within a few hours in a large sized hematoma with accompanying shock.[11] Small hematomas may be carefully watched and treated with ice bags and compression. If, however, an increase in size is noted, they should be treated in the manner outlined above.

Vaux[12] reports a mortality of 12 per cent and Hamilton,[13] in a series of twelve cases, reports a mortality of 8.3 per cent, the one death occurring in a primipara in whom a mass of the left labium was treated expectantly. The mortality in the subperitoneal variety is between 50 and 60 per cent. Primiparae are affected a little more frequently than multiparae, and the hematomas occur more often following spontaneous delivery.

A summary of the following four cases of postpartal hematomas is presented. Three of the patients were treated actively and one was treated expectantly. Uneventful recovery followed in all instances.

CASE REPORTS

Case I. A twenty-eight-year old white woman, gravida II, para I, with a negative past personal and prenatal history, entered Cumberland Hospital in labor. On June 21, 1941, she was delivered spontaneously of a normal seven-pound, two-ounce infant from the L. O. A. position after six and one-half hours of labor. A second degree laceration was repaired with interrupted No. 2 chromic sutures. Five hours later the patient went into shock. With pressure on the fundus, which was firm and three finger breadths above the umbilicus, a stream of frank blood was noted coming from the vagina. Vaginal examination revealed bluish discoloration of the posterior vaginal wall, the mucous membrane of which was elevated for a distance of about 10 cm. There was an abraded area at the summit of this fluctuant elevation and at this point the mass was opened by blunt dissection. About 300 cc. of blood and clots were evacuated and no bleeding points were noted. Exploration of the cavity disclosed that it extended into the ischiorectal fossa and perianal area. The cavity was packed with ten yards of one-inch and two yards of five-inch gauze, soaked in 1:1000 solution of merthiolate. The vagina was then packed with five yards of five-inch gauze. The patient was given an infusion of plasma, followed by a transfusion of whole blood, and her general condition improved. The vaginal packing was removed in twenty-four hours and the packing in the ischiorectal fossa was removed in forty-eight hours. The patient was discharged from the hospital on the twelfth postpartum day.

Case II. A thirty-two-year old, white woman, gravida II, para I, entered the Prospect Heights Hospital on January 11, 1941. After ten hours of labor she was delivered of a normal six-pound, fourteen-ounce infant from the L. O. A. position by low forceps. A right medio-

lateral episiotomy was repaired. For five hours postpartum the patient experienced lower abdominal pain. Examination revealed that the right labium majus was swollen to the size of a grapefruit and the skin over it was smooth, glossy and bluish. The vaginal canal was distorted by this soft mass adjacent to the right vaginal wall. The episiotomy wound was opened widely and large masses of blood clots were evacuated from the right vulval and paravaginal space. The latter was tightly packed with two strips of one-inch gauze of five yards each. For counter-pressure the vagina was tightly packed with ten yards of two-inch plain moist gauze. The patient was then given a blood transfusion. The vaginal packing was removed in twenty-four hours. The packing in the paravaginal space was removed in forty-eight hours. The patient was discharged from the hospital in good condition on the thirteenth postpartum day.

Case III. A thirty-five-year old, white, obese woman, gravida VII, para VI, with an antenatal history of toxemia, entered Cumberland Hospital and was delivered spontaneously on April 16, 1940, after five and one-half hours of active labor. Several small mucosal tears were noted in the vagina during the second stage and when the head began to distend the vulvovaginal ring, a large hematoma of the left labium majus gradually appeared. No increase in the size of the mass was noted and the general condition of the patient remained good. Ice compresses were applied to the hematoma after delivery. The mass gradually decreased in size with this treatment. No induration, tenderness or swelling of the vaginal walls was noted at the time of discharge from the hospital on the ninth postpartum day. In this case the expectant plan of treatment was carried out successfully. This type of management was chosen because the general condition of the patient was good, there was no evidence of bleeding, and the mass did not increase in size.

Case IV. A twenty-eight-year old, white woman, nullipara, entered the Swedish Hospital on February 20, 1941. She was delivered spontaneously of a normal female infant weighing seven pounds and one ounce, after fourteen hours of labor, from the R. O. A. position. A right mediolateral episiotomy was repaired. Sixteen hours after delivery the patient began to complain of pain in the perineum, and vaginal bleeding was noted. She felt faint and appeared pale. The blood pressure was 80/60 and the pulse 92 per minute. Examination disclosed a hematoma of the right labial and perineal areas, extending down to the right buttock. Following a transfusion of whole blood, the sutures were removed from the episiotomy wound, and large blood clots were evacuated from its bed and from the right ischiorectal fossa. A continuous ooze was noted from the upper angle and lateral wall of the episiotomy wound. This was controlled by packing the hematomatous cavity. The vagina was then packed tightly and a retention catheter was placed in the bladder. The patient was given a second transfusion and her general condition improved. The vaginal packing was removed in twenty-four hours and the ischiorectal packing in forty-eight hours. The patient was discharged from the hospital in good condition on the twentieth day postpartum. The bleeding, coagulation and prothrombin time were normal.

SUMMARY

1. A summary of the etiology, recognition and management of postpartum vulvar and paravaginal hematomas is presented.

2. Four cases of this postpartum complication are reported.

3. Three patients of this group were treated actively by opening of the hematoma, evacuation of the blood clots and packing. In addition, blood transfusions and supportive therapy were given. All patients made an uneventful recovery.

4. One patient progressed satisfactorily and fully recovered under expectant treatment.

CONCLUSIONS

1. The possibility of labial or paravaginal hematoma occurring as a postpartum complication should be borne in mind.

2. The self-limited case can be adequately treated expectantly and conservatively.

3. Those cases which show signs of failure to become self-limited should be treated actively in the manner advocated by Hamilton, namely, incision, evacuation

of blood clots, packing, and supportive therapy as indicated.

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Paravaginal hematoma and hemorrhage within the broad ligaments are quite easy to diagnose, as a rule. Retroperitoneal, being much slower, as a rule, than intraperitoneal hemorrhage, and inaccessibly situated, is probably the most difficult of all these conditions to diagnose.

SUBASTRAGALOID DISLOCATION

REPORT OF AN UNUSUAL SKI INJURY

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DISLOCATIONS about the ankle joint involving the astragalus are rare. Key and Conwell describe the force involved as being a severe torsion, but remark that this force usually accounts for fractures or fracture dislocations. Very few cases of subastragaloid dislocations, without fractures, have been reported.

FIG. 1. Complete dislocation of the os calcis on the talus with 90 degrees lateral rotation.

The typical description of this dislocation (Key and Conwell) is that the astragalus remains in the mortise of the ankle joint and the foot is displaced forward, backward, inward, or outward, depending on the force involved in the injury. The subastragaloid and astragaloscaphoid joints are displaced upon the astragalus. Clinically, this distortion of joints results in severe swelling and complete disability of the foot and ankle with the foot fixed in an abnormal position in relation to the leg. Because of the twisting and distortion of tissues, circulatory changes may occur soon after the injury. This factor necessitates immediate reduction of the dislocation.

The following case report illustrates the dislocation at the subastragaloid joint as produced by a force of external rotation.

CASE REPORT

The patient was admitted to the Station Hospital December 6, 1942, with the complaint of pain and swelling of the right ankle. Under authorized skiing he was coming down a hill at a moderate speed, but lost control and began to fall. A tree nearby caught the front end of the ski; and as the forward momental force carried the weight of his body past the tree, a torsion external rotating force was produced on the left ankle. Immediately after the fall the patient was unable to bear weight and noted that his left foot was displaced outward in comparison to the right foot. He was brought to the hospital immediately following the accident.

Physical examination on admission showed marked deformity of the left ankle with the foot projecting at a 90 degree angle lateralward in relation to the leg. There was marked deformity of the ankle joint with general diffuse swelling. There were some ecchymoses medial and lateral over the os calcis portion of the foot and below the ankle joint proper. There was slight motion in the ankle joint but this motion produced severe pain. No crepitation could be found. Palpation during examination indicated excruciating tenderness in the area of the involved joint.

X-ray studies showed a complete dislocation of the os calcis on the talus with 90 degrees lateral rotation of the foot, the scaphoid bone being separated anteriorly from the talus. There was no fracture apparent. Reproduction of the preoperative *x*-ray film is shown in Figure 1.

Immediately following the completion of the diagnosis, the patient was given morphine

sulfate gr. ½ and atropine gr. 1/150 hypodermically. Preparations were then made for reduction of the dislocation under anesthesia. Time was allowed for the narcotic to become effective, then the patient was given sodium pentothal .25 Gm. intravenously. With the patient completely relaxed, gentle manual traction and internal rotation was accomplished with sudden and nearly complete reduction of the dislocation. *X*-ray examination immediately after reduction showed nearly complete reduction except for a slight forward displacement of the astragalus with the foot in a semiflexed position.

The day following reduction, December 7th, with the extremity in a circular cast to the tibial tubercle, the *x*-ray checkup showed the foot in approximately 85 per cent dorsoflexion and the talus remained displaced slightly forward. This slight displacement was corrected by removal of the original cast and recasting the extremity with the foot in full dorsoflexion.

Fig. 2. Fig. 3.

Fig. 2. Anteroposterior and lateral projections.
Fig. 3. Post-reduction showing anatomic relationships of the ankle joint.

The cast was worn two weeks and *x*-ray checkup December 21, 1942, showed a normal left ankle joint. (Figs. 2 and 3.) On this day the cast was removed and weight-bearing was allowed. In four days swelling was no longer present and good joint motion was present without pain or stiffness. The patient was discharged to full duty approximately four weeks after the injury.

SUMMARY

A case of subastragaloid dislocation of the left ankle occurring during authorized military skiing is reported.

New Instruments

MODIFIED OVERHEAD SUPPORT FOR POSTOPERATIVE USE

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THE use of an overhead support on the bed of postoperative patients is not new. For the most part, however, its use has been confined to traumatic and orthopedic cases. The standard textbooks on surgery and postoperative care, for example, make no mention of its use in abdominal surgery. We first became interested in its greater possibilities after a visit to the Massachusetts General Hospital where we saw the Balkan frame being employed on the surgical services for the older age group of patients and for hernia cases. So obvious are its advantages, and so pleased are we with the results obtained that it is difficult to understand its lack of wider acceptance. In this day of overtaxed hospital personnel, anything which lessens the amount of nursing care re-

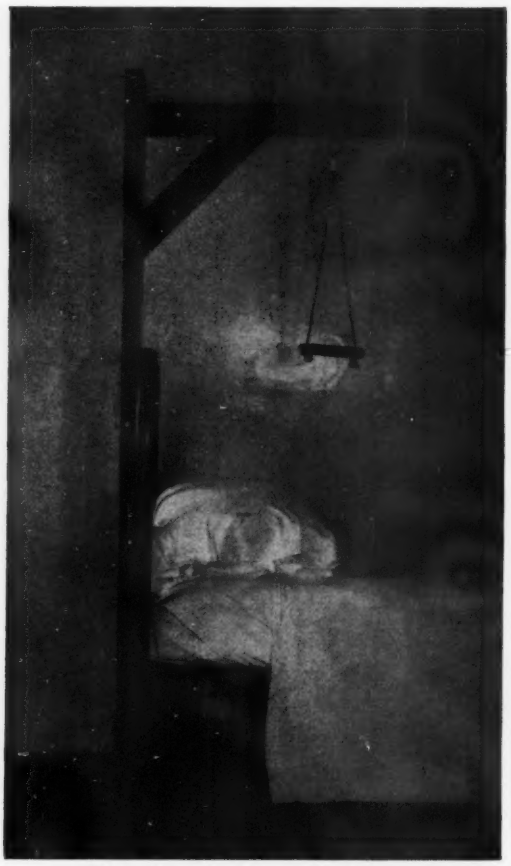

FIG. 1. Side view showing 26 inch cross bar of 1¾ by 3 inch white pine inset into upright 6 feet 6 inches high. Site of 4 inch long three-eighths eye bolt, easily varied.

FIG. 2. Front view showing fixation of trapeze to prevent side slip.

quired—and the overhead support most assuredly does that—deserves thoughtful consideration. It is because of this, that a modified type of overhead bar which seems to us to offer several advantages, is being presented.

Fig. 3. Rear view showing 2 by 6 inch white pine upright fastened to bed by rope ties.

At first, we, too, used a Balkan frame. The insufficient number available never seemed to be where needed, and the job of transferring and setting them up required time and was not one for the nursing staff. Various adaptations were tried, each one having some drawback. Finally, with the assistance of Mr. Wenzel, the hospital carpenter, the overhead bar shown in the illustrations was evolved. It is inexpensive and easy to construct, hence, a large number can always be kept at hand. It is adaptable to all bed types; it is adjustable to suit the patient. It is light in weight and can be readily transported and set up by a nurse. It has proved highly satisfactory to patients, doctors and nurses alike, and is now widely used in our hospital by all the surgeons as well as by some of the medical men. Whether or not such an apparatus is responsible for the lowered morbidity and mortality figures we are experiencing postoperatively is difficult to determine, because so many factors are involved. We do know, however, our patients now require less nursing attention and care. This alone would seem to justify its wider adoption today.

SIMPLE APPARATUS FOR THE CARE OF AN ILEOSTOMY

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THE avoidance of ulceration about an ileostomy which has been performed is always a matter of concern to the surgeon. The problem is not frequently encountered and yet, when it is encountered, much time is lost and damage done before a satisfactory method of caring for the irritating discharges is adopted. There are several well known methods of caring for the ileostomy stoma; all of these require a particular skill and watchful care to be satisfactory. The following apparatus has been used successfully by the author:

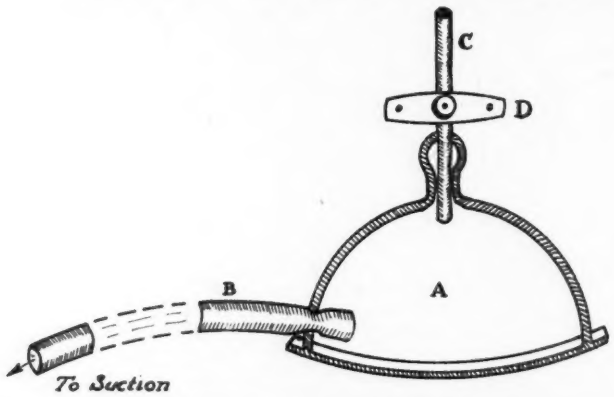

FIG. 1. Lateral diagrammatic view of ileostomy apparatus. A, Latex rubber nursing bottle cap. This is placed over the ileostomy, the flanged rim becoming imbedded in the vaseline gauze dressing surrounding the stoma. B, large soft rubber urethral catheter, from which the tip and a part of the flared end have been removed. The distal end of this catheter connects with the suction apparatus. C, piece of small soft rubber catheter. D, Hoffman clamp. Catheters B and C have been inserted through small holes in the lower portion of the dome of the nursing bottle cap, and in the tip of the nipple of the cap, respectively.

The main portion of the apparatus consists of the latex rubber cap of a wide-mouth, infant nursing bottle. Caps of this type are available commercially. The essential features of the cap are a nipple, a large dome and a flanged rim. The first step in the preparation of the cap is to cut two small holes. One, about 2 mm. in diameter, is cut in the center of the nipple, and the other, about 3 mm. in diameter, is cut in the dome adjacent to the flanged rim. The latter hole is best placed by the point where the flange is broadened to form a tab. A large, soft-rubber, urethral catheter (about No. 26 Fr. in size) is then lubricated with soap and drawn out through the hole at the edge of the dome of the cap. Almost the entire catheter, tip first, is drawn through until the flaring end of the catheter protrudes only slightly beyond the concave inner surface of the dome of the nursing bottle cap. Before inserting the catheter it is well to cut off the less rigid distal one-half inch of the flared end. A second, small, soft-rubber, urethral catheter (about No. 12 Fr. size) is then drawn out through the hole in the nipple by the method just described. It is well to have removed the

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flared end of this catheter and to allow it to protrude into the lumen of the nipple for a distance of about one inch. Finally, the tips of both catheters are cut off, leaving the larger catheter long and shortening the smaller catheter so that it protrudes only about two inches from the nipple.

This apparatus is applied to the ileostomy in the following fashion: The surface of the skin adjacent to the ileostomy is cleaned, dried and completely covered with several layers of vaseline gauze. The apparatus is placed over the ileostomy so that the flanged rim rests on the bed of vaseline gauze. The larger catheter is connected to a suction apparatus and the smaller catheter is held pinched off by a Hoffman clamp. When suction is started the flanged rim of the cap becomes firmly imbedded in the vaseline gauze, forming an air tight seal about the ileostomy stoma. The suction serves not only to hold the apparatus in place but it removes liquid and gas as soon as they are discharged from the stoma.

Any type of apparatus giving continuous suction may be used. The commonly used three-bottle siphon system is entirely adequate. The Hoffman clamp may be opened slightly in order to modify a too powerful negative pressure, or it may be opened widely to flush out the apparatus with air of saline. It has been found that a daily dressing with renewal of the vaseline gauze is adequate. The apparatus may be discarded when the discharges take on the characteristics of ileostomy stools.

Fibro-adenomata of the cervix differ from those arising in the endometrium only in the fact that they are rough on the surface, are covered with the cervical type of mucosa, and do not usually exhibit the changes of the menstrual cycle.

The brief excerpts in this issue have been taken from "Essentials of Gynecology" by Willard R. Cooke (J. B. Lippincott Company).

Bookshelf Browsing

AMERICAN PIONEERS IN ABDOMINAL SURGERY

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THE rise of specialism and its rapid advancement is the most startling single feature of modern medicine. Surgery as a distinct specialty is representative of the various specialties. The changes wrought in abdominal surgery during the past fifty years are so amazing that to recount a surgeon's experience of that period would simulate an apocryphal tale.

Less than a century ago the most serious operations were performed without the aid of anesthesia and without the benefit of the most rudimentary aseptic precautions. Even in 1890 abdominal operations were infrequently performed. An appendectomy was a rare procedure and the surgical technic of the period was gruesome.

It is related how Dr. Alexander Mott, dressed in a Prince Albert coat, with white shirt cuffs showing, operated at Bellevue. He would put the scalpel in his mouth with several strands of waxed silk. The sponges used were ordinary reef sponges kept in the usual type wash basin. The water was changed only when it became too bloody. Instruments were kept in a mahogany box carrying case. When the operation was completed, the instruments were dried and replaced in the velvet-lined box for the next patient.[25]

From this primordial beginning has been formulated a highly technical and scientific specialty. Early American surgeons were concerned in applying the surgical knowledge in America which they had gained from Europe. Our surgeons of this century have advanced beyond their preceptors and now enjoy the leading world position in surgical progress and practice. With the acquisition of this leadership, the debt of gratitude which the world owes to American surgery has increased beyond all estimation. Although many nations, older than America, have contributed many notable accomplishments, pioneers in American surgery evolved the basis for the modern advancement of this specialty. This advancement is displayed not only in regard to original research but in the introduction of newer methods of treatment, in the perfection of older operative procedures, and in tangible results. These achievements of American surgery cannot help but elicit universal admiration from the surgeons of the world. What our country has contributed to the creation of modern abdominal surgery is the worthy subject of this essay.

COLONIAL SURGERY

When the colonies were about to be molded into a nation, the name of no American appeared upon the honor scroll of brilliant men who had made the surgery of the world famous. Occasionally, an outstanding surgeon is noted, but his fame is purely local. Others, such as Dr. Warren and Dr. Prescott, were imbued with the patriotic spirit, thereby forsaking their profession for the cause of liberty. It was through their efforts that the movements of the British troops were reported to the colonial army. In the colonial army itself Dr. Jones was the best known surgeon (from 1775 to 1781). Among the great things which medical officers of the American army have contributed to medicine,

attention is drawn to the first American book on surgery. This was written by Surgeon John Jones, U.S.A. (1729–1791) which was published in 1775. This book contains many pages on the treatment of war injuries and detailed descriptions of amputations. Jones was appointed the first occupant of the chair of surgery at Columbia University.[15] The first professor of surgery in colonial America was William Shippen (1736–1808). At one time he was Director General of the Continental Army. He was appointed professor of surgery at the University of Pennsylvania in 1766.[15]

The turbulent days of the period permitted no chronology of medical history. For this reason scattered individual surgical contributions are recorded as indicative of the progress in colonial America. The honor of leading the procession belongs to John Bard (1716–1799) of New York. In 1759, Bard performed what is called a "gastrotomy" for extra-uterine pregnancy. This procedure was subsequently repeated in 1791, and again in 1799, by William Baynham (1749–1814). Samuel (1742–1821), the son of John Bard, organized Columbia Medical School becoming its first dean. He was physician to George Washington when the seat of government was in New York. A name worthy of mention is Thomas Bond (1712–1784). He was apparently the first in the United States to perform a lithotomy. Bond and his son, Phineas Bond, rendered a distinguished service in 1776 by actively organizing the medical department of the colonial army. As an interesting notation it is recorded that Benjamin Franklin invented the flexible catheter.[8]

These patriotic men of medicine were our first practicing surgeons. Courageous in war and science, it was they and their successors who founded our schools of medicine and brought into being American surgery.

FOUNDERS OF AMERICAN SURGERY

The history of great deeds is basically the story of the men who have perfected them. In the history of surgery two men stand forth as the fathers of American surgery: Philip Syng Physick and Ephraim McDowell.

Philip Syng Physick (1766–1837) studied at the University of Pennsylvania under Adam Kuhn and then went abroad to study under John Hunter. In 1792, he received his degree from Edinburgh. In 1794, he was elected surgeon to the Pennsylvania Hospital. Later he was made professor of surgery at the University of Pennsylvania. As a teacher he acquired the title, "Father of American Surgery." One of his most publicized operations was the lithotomy performed on Chief Justice Marshall, in 1831, when the judge was in his seventy-fifth year. Physick was one of the first surgeons to employ gastric lavage. He perfected an operation for the cure of "artificial pouches" (diverticuli) in the alimentary canal (1809). He devised a procedure of ligating artificial openings (fistulas) which had been made in the intestine due to pathological changes. Among his other achievements may be mentioned his description of rectal diverticuli and his operation for artificial anus (1826). As an innovation he introduced the use of kid and buckskin ligatures (1816) and invented the tonsillotome.[22]

The dawn of abdominal surgery starts with the historical scene in Danville, Kentucky, 1809. Dr. Ephraim McDowell (1771–1830), an unknown pioneer surgeon, trained in Edinburgh, was called to see Mrs. Jane Todd Crawford, sixty-five miles away in Greenville. The story of how she consented to submit to ovariotomy is too well known to recount. In the subsequent years, McDowell performed the operation twelve times, seven of which were successful. His valiant initiative was a great stimulus toward the development of American surgery. As the originator of this operation he made possible the development of the present field of abdominal surgery. McDowell's pioneer surgery will live in the memory of science as long as time endures.

Encouraged by the splendid results of McDowell, other American surgeons began to report their successes. Four years later a complete hysterectomy was performed by Joseph Glover of South Carolina (1813). Two surgeons, brothers, John Light Atlee (1799–1885) and Washington Lemuel Atlee (1808–1878) assisted in establishing ovariotomy after McDowell. They elaborated a procedure which enabled them to perform 465 operations in 1842 and 1843.[11] Other names prominently associated with ovariotomy are Nathan Smith, Dunlap, Peaslee, Kimball, Sims and Thomas. Against all these men the most caustic invectives were hurled. Yet their fearless efforts resulted in the acceptance of this procedure. To them must be given the gratitude of the world, since they brought a light into this dark region of surgery.[6]

Not many realize the profound influence McDowell's first ovariotomy had upon the entire field of abdominal surgery. An infant nation had startled the world in the fearful and formidable operation of extracting diseased ovaries. There was no precedent to warrant such surgical interference. Yet guided by a correct knowledge of pathology and possessed of trained operative skill, McDowell performed his part well. When the patient recovered, the drama was completed. Ovariotomy was given to the world and the name of the first American surgeon was immortalized on the honor roll of medical history.

THE WARREN FAMILY

The fortunes of war during the struggle for independence resulted in many casualties. For the treatment of the wounded an army hospital was established in Boston. The surgeon was Dr. John Warren (1753–1815). It was his desire to utilize the clinical material of the hospital for teaching purposes. In addition to clinical instruction, he held formal lectures in anatomy. These lectures were attended by Harvard students who were to undertake the study of medicine. Interest was drawn to this instruction by the large quantity of students who visited his lecture hall. The Harvard authorities invited him to lecture at Cambridge as well as to assist them in the founding of a medical school (1780). Dr. John Warren was a younger brother of Dr. Joseph Warren who fell at Bunker Hill. He had served as an army surgeon throughout the war. During the postwar years he attained much eminence in Boston.[3]

John Collins Warren was born in Boston (1778). He was the eldest son of Dr. John Warren and the nephew of General Joseph Warren, who did so much for colonial liberty. Graduating from Harvard College (1797) he read medicine with his father, finally journeying to Paris and London for further study. He graduated from Edinburgh with a doctorate. When he returned to Boston, he began to practice with his father (1802). Four years later, he was made adjunct professor of anatomy and surgery and finally full professor when his father died (1815). He resigned from the chair of surgery at Harvard in 1847.

Among Dr. Warren's greatest accomplishments was the founding of the *New England Journal of Medicine & Surgery* with Dr. Jackson and Dr. Bigelow. He assisted in the formation of the Massachusetts General Hospital and served as its first surgeon from 1820 to 1853. The most famous event in his professional life was the operation he performed under ether on October 16, 1846. This operation demonstrated the value of ether in the advancement of modern surgical anesthesia.[5]

After the death of John C. Warren (1855) his son, Jonathan Mason Warren (1811–1867), continued the family tradition as one of the most renown Bostonian surgeons. Following his graduation from Harvard, he sojourned in Europe. While in London he visited the clinics of Sir Astley Cooper; in Paris he witnessed the work of Dupuytren, Lisfranc and Larrey. Returning to Boston he began to practice (1835). In 1846, he became one of the visiting surgeons to the Massachusetts General

Hospital where he assisted his father in that memorable ether operation. While returning from a meeting of the American Medical Association in New York, the train on which he was a passenger was wrecked (1853). Although he was not actually injured, his health was seriously impaired thereafter until his death (1867).

Jonathan Warren had a son, John Collins Warren, who, like his father, graduated from Harvard (1886). He, in turn, became a professor of surgery and attending surgeon to Massachusetts General Hospital. As editor of the *Boston Medical Journal* he contributed much to surgical literature. At the time of his death (1927) he had served as president of the American Surgical Association.

The family heritage is carried on by his son, John C. Warren, who was an associate professor of surgery at the time of his father's demise. There are few, if any families, to contribute so much to the history of American surgery. No one could seek a more spotless record in the annals of medical history than that presented by the Warren family.[23]

PRE-ANESTHETIC SURGEONS

The years preceding the use of anesthesia is properly termed the rough years of surgery. Surgeons had to be stronger than the patient in order to restrain the subject and defend himself from the patient's outbursts. Too often the surgeon was not able to concentrate his attention upon the surgical task because of the cries and struggles of his patient.

A great surgical pioneer of this period was Valentine Mott (1785–1865) of New York. His many operations are too numerous to relate. Ligating of vessels was his most daring feat. In this dangerous preanesthetic and pre-antiseptic era he successfully ligated 138 aneurysms. On one occasion he ligated a common iliac artery through the abdomen (1828). When he was professor of surgery at Rutgers College, he wrote: " . . . we think it may henceforth be regarded as an axiom that it is the duty of a surgeon to operate in every case which allows of a rational hope of success, either of improving the patient's condition or of preserving his life. . . . We do not believe it proper for every man who is nominally of the profession to assume such high responsibilities but that we regard those as surgeons, and those alone, who have, by conscientious devotion to the study of our science, and the daily multifarious duties, acquired that knowledge which renders the mind of the practitioner serene, his judgment sound and hands skillful; while it holds out to the patient rational hopes of amended health and prolonged life.*

Mott was a bold operator, a pioneer teacher of clinical surgery, and one of the earliest professors of surgery in New York. When the Civil War was declared he was an old man. Nevertheless he assembled many valuable notes which he employed to write his excellent monograph on hemorrhage. This treatise was published by the U.S. Sanitary Commission.[2]

Another eminent surgeon was Willard Parker (1800–1885). He was famous for his original surgical technic which attracted many students to Columbia Medical School. Here he was professor of surgery (1839–1860). Among his proficient operations was cystotomy, a procedure which he perfected for the repair of the bladder following rupture or the removal of calculi.

During these formative years in American surgery, a laparotomy was performed by a southern surgeon, Dr. Wilson (1831). This was undertaken for the relief of an intussusception in a negro slave who had an intestinal obstruction for seventeen days. The abdomen was opened and the intussusception released with complete recovery of the patient.

Other interesting surgical undertakings were recorded. Dr. Joseph Glover, of South Carolina, removed part of the spleen, some omentum and ligated a branch of the splenic vessels (1801). A traumatic injury

* Am. J. Med. Soc., vol. III, 1829.

to the spleen due to gunshot wound gave Dr. Alston, of Texas, the opportunity to perform a splenectomy (1863).[8,22]

Elective surgery was not a feature of the pre-anesthesia decades. Surgical intervention was an emergency, life-saving undertaking. Patients were coerced into submitting to surgery, either as a last resort or because their unconscious state rendered objection impossible.

AMERICA'S GREATEST SURGICAL CONTRIBUTIONS

There are two non-surgical subjects which have profoundly accelerated surgical progress: The first is the introduction of anesthesia, and the second is the elucidation of shock. Both these topics are truly American. No other nation can claim priority for the discovery of the former, and no one has contributed more to the understanding of the latter than American surgeons.

A great change has been brought about in the practice of abdominal surgery by the introduction of anesthesia. Patients will now consent to operations which formerly they would rather have died than endure. Thus many new operations which would have been impracticable are now feasible. In this way the range of operative surgery has been greatly extended. By means of anesthesia the patient is liberated from pain and in a great degree from the mental anxiety and disquietude which formerly preceded an operation. This is undoubtedly a contributing factor in di-diminishing the physical shock of an operation.[1]

The discovery of anesthesia produced a bitter discussion as to the real discoverer. Dr. Crawford W. Long (1815–1878), of Georgia, was the first man to use ether as an agent to relieve the pain of surgical operations. In 1847, he administered ether to his own wife at childbirth and continued to use it in his obstetrical practice. Long's classical operation occurred on March 30, 1842. On that day a man named James Venables, while under the influence of ether, had a small cystic tumor removed from his neck. Long did not push himself into the arena as a claimant for the honor of the discovery of anesthesia until 1854. At that time he wrote to Senator Dawson of the U. S. Senate giving him an account of what he had done.[23]

To William T. Morton (1819–1868) is given the credit of demonstrating the practicability of ether anesthesia. Morton graduated from the Baltimore College of Dental Surgery, and entered into partnership with Dr. Horace Wells to practice dentistry in Boston. On September 30, 1846, he extracted a tooth while the patient was unconscious from ether. It was on this day that he spoke to Dr. C. T. Jackson on the subject.

Morton was anxious to receive the approbation of the medical profession on ether anesthesia. He called on Dr. Joseph C. Warren and explained his anxiety in the matter. So it came to pass that Dr. Warren, with Dr. Morton as anesthetist, removed a tumor from the left side of the face of Gilbert Abbott (October 16, 1846).

Among the many other names associated with anesthesia is that of Horace Wells (1815–1848). He was a dentist who observed a young man who had inhaled nitrous oxide bruise himself against furniture without complaining of pain. The next day he gave himself the gas and allowed a Dr. Riggs to pull one of his teeth. He felt no pain (1844). He at once began the manufacture and use of nitrous oxide. Wells attempted to gain priority rights as the discoverer of anesthesia. While the anesthesia controversy was raging he committed suicide in 1848.[23]

One blemish mars the beauty of the anesthesia doscovery. The scar is the altercation for fame among the pioneer anesthetists. It is not of great importance to defend the true discoverer of anesthesia. Suffice it to be acclaimed as a true American discovery; no other nation can question this claim. The incalculable assistance given to abdominal surgery by this dis-

covery cannot be described adequately. This American discovery was the first revolutionary contribution recorded in surgical history. It is a disclosure touching the brim of metaphysics—a safe substance producing anesthesia and inducing sleep. All the influences emanating from the introduction of anesthesia is attributed to it. Thus the progress which abdominal surgery has made from year to year owes its origin to an American discovery.

America's greatest contribution has been surgical anesthesia. Nevertheless there is another contribution, less dramatic perhaps, but none the less highly commendable. The subject of shock has been elucidated largely through the efforts of Americans. No individual beams forth in the unfolding picture on the nature of and treatment of shock, as in the drama of anesthesia.

At the birth of this century the nature of shock was a nebulous enigma. Only the crudest ideas were postulated by surgeons of the world as to the mechanism of shock. All realized how serious and frequent a complication this was following severe injuries and major operations. The world of medicine was eager to listen to some voice in the wilderness which would raise the pall of ignorance. None was heard until George W. Crile (1864–1942) published the results of his investigations (1899). Although his conclusions were not correct, nevertheless his work stimulated others to exert their efforts to solve this perplexing problem.

More recent years produced notable facts which have assisted in clearing the mist surrounding the mechanism of shock. The modern American investigators, Blalock, Keith, Phemister, Moon, Scudder and others have added greatly to our knowledge of this subject. To those other Americans who have studied the problem of combatting shock by employing blood and blood substitutes is due a laurel wreath of unfading fame. Through the efforts of Americans the ever present complication of shock, hardly less important than infection, is on the road to exile from the modern operating theatre.[6]

TRANSITION PERIOD

Between the pre-antiseptic, pre-anesthesia decades and the era of aseptic, analgesic surgery was a period of blending of one with the other. Most important of those surgeons who crossed this bridge of transition was Samuel David Gross (1806–1884). Often called the Nestor of American surgery, he was the foremost American surgeon of his time. Gross invented many new instruments, was a prolific writer, and introduced deep sutures in wounds of the abdominal wall. As a medical historian he wrote a history of American surgery down to the year 1876. In addition, his *System of Surgery* published in 1859 was widely distributed. Dr. Gross was a popular teacher of surgery first at Louisville (1840) then at the Jefferson Medical College (1856). He did more for the advancement of American Surgery than any individual of his day. He was panurgic in his ability. Not only was he an original investigator and proficient operator, but as a teacher and writer he was a notable exponent of his craft.[4]

The most outstanding of the New England Surgeons at this time was Henry Jacob Bigelow (1816–1889). As professor of surgery at Harvard, and surgeon to the Massachusetts General Hospital he achieved fame for the bloodless reduction of the hip joint. So great was his influence in Boston that his words were accepted as dogma. Much is due to Bigelow for his efforts to establish the administration of ether as a permanent part of operative technic. He is well known as a pioneer in genitourinary surgery.

D. Hayes Agnew (1818–1892) was born in Pennsylvania and graduated from that university in 1838. His early days in medicine were as a country doctor. When he moved to Philadelphia, he began to teach in the Philadelphia School of Anatomy (1848). In 1870, he was appointed professor of clinical surgery at the Uni-

versity of Pennsylvania. In the following year he succeeded H. H. Smith as professor of the principles and practice of surgery. He achieved national fame by his attendance of President Garfield during his last illness.

When Dr. Agnew became Professor Emeritus of Surgery, his successor was John Ashhurst, Jr. (1839–1900). He was one of the most learned surgeons of America and a great teacher. Ashhurst, who disdained the use of antiseptics, claimed operative results as regards infection as good as those of the more progressive Agnew. Often his results were unwittingly obtained by observing simple cleanliness.[4] No man ever used his vast experience and profound learning to better purpose in the instruction of those who were to come after him.[11,23]

Another bright star in the surgical heavens was William Williams Keen (1837–1932). As professor of surgery at Jefferson Medical College he was one of the first to perform many surgical procedures. He not only contributed novel innovations to general surgery but invented new technics for sterilizing catgut, and was a pioneer in neurological surgery. He was a noted author, achieving renown for his *System of Surgery*. He wrote an essay on the *Early History of Practical Anatomy* (1870).

James Marion Sims (1813–1883) was not primarily an abdominal surgeon but a gynecologist. Nevertheless his rules of surgery were so influential that general surgeons followed his dictum on penetrating wounds. He maintained that a wound of entrance should be enlarged for adequate exposure; all wounded intestines should be sutured and bleeding vessels ligated; the peritoneal cavity should be thoroughly cleansed of all foreign matter before closing the external wound; the surgeon should decide whether the wound required drainage.

All these former surgeons of the transition period assisted in completing the metamorphosis in American surgery. They were the link which united primitive to modern American surgery. With the passing of these notable figures, America became a leading figure in the world of medical science. In the subsequent decades America is to assume the dominating leadership in the world of surgery.

AMERICAN PIONEERS IN ASEPSIS

When Lister visited the United States at the International Medical Congress held in connection with the Centennial Exposition at Philadelphia, ten years had passed since his doctrine of antisepsis was promulgated (1876). His teachings in America were accepted with indifference.[19]

The reasons for American lethargy in this important aspect of surgery were several: First, the treatment procedure was changed so often that surgeons could not adapt themselves to frequent alterations. Secondly, the procedures advanced were so complicated that the surgeon himself had to be responsible for its proper administration. Lastly, the hostility of so many British surgeons (Nunnelly, Paget, Humphrey, Callender, Tait, etc.) to Listerism minimized its importance to Americans.[27]

In appraising the early history of aseptic surgery in America, scattered apostles of Listerism are seen in several large cities. New Orleans, Chicago, New York and Baltimore were the domiciles of ardent advocates of asepsis.

Hostility to asepsis and skepticism were present among the surgeons of New Orleans. The only exception was a German surgeon, Dr. Moritz Schuppert (1817–?), born and educated in Marburg. As professor of surgery in the Charity Hospital Medical School he championed the cause of antiseptic surgery. In a lecture published in the *New Orleans Medical and Surgical Journal*, Schuppert stated: "Reports that the antiseptic treatment of wounds recommended by Lister promised to cause a revolution in surgical practice, did not permit me to rest, and the Spring of 1875 found me already on the road to visit those places from which such stunning facts

were reported." At the conclusion of this extensive monograph, he summarized his own experiences based on his personal operations in New Orleans at Charity Hospital.

Despite the excellent exposition of the subject by Schuppert, Listerism made very slow progress in Louisiana and the United States. This was due in no small measure to the antagonism of many American surgeons. As learned and progressive a surgeon as Ashhurst was, he wrote in his textbook: "The alleged superiority of the antiseptic method has not yet been demonstrated." This was eleven years after Lord Lister had issued his first announcement of the antiseptic doctrine.[19]

The topic of antisepsis has been an evolution in which several American surgeons were important contributors. To Edmund Andrews (1824–1904) and to Christian Fenger (1840–1902) goes the honor of first using aseptic technic in Chicago. Of the two, Christian Fenger was the more influential.

In the spring of 1878 he began to give lectures and demonstrations in pathology. This was a science unknown to Chicago physicians. Fenger quickly accepted the importance of surgical asepsis and introduced Listerian methods in the Cook County Hospital. After several years as pathologist, he so impressed the surgeons with his surgical knowledge, that he was appointed to the surgical staff at Cook County Hospital. Finally, in 1889, he was elevated to the surgical professorship at Rush Medical College.[14] Fenger was the first American surgeon to prove by autopsy the importance of aseptic technic. Necropsies before the acceptance of the principles of asepsis and antisepsis in surgery often disclosed not the disease from which the patient suffered during life but the complications that had caused death.[14]

Arpad G. Gerster (1848– ?) was born in Hungary and educated abroad. He came to America and settled in New York. As an accomplished surgeon he was an attending surgeon at the German and Mt. Sinai Hospitals. He was the first man in New York to practice surgery exclusively. In 1888, he published "The Rules of Aseptic and Antiseptic Surgery." This essay enjoyed a wide circulation, even as it stimulated surgical asepsis and an appreciation of abdominal surgical diseases.[8]

The most startling American contribution to aseptic technic occurred in 1890. William S. Halsted introduced the use of sterile rubber gloves by surgeons and his assistants in the operating room. The employment of "the boiled hands" brought about a radical change in surgical technic. The beneficial results of this contribution cannot be overestimated.

The development of surgical asepsis is indicative of the universality of the medical art: it was introduced by an Englishman and was adopted and advanced by continental nations. An American surgeon by the utilization of rubber gloves not only gave greater security to the manipulations of surgery, but protected the surgeon's hands from the harshness and injurious effects of chemical antiseptics. This is an example of how American surgeons have transformed the picture of modern surgery so that it no longer possesses its former appearance.

PERIOD OF REORGANIZATION

The postwar years of 1865 to 1898 in the United States were termed the reorganization period. For it was during these years that America turned to the reunion of the states, healed its wounds and accepted the new changes produced by the industrial revolution.

The effects of reorganization found its way into medicine. Prior to this period there was no central collection of medical literature and no method available for ascertaining what scientific material had been published. The Library of the Surgeon General's Office was a small collection of books which were inadequate. To John Shaw Billings (1838–1913) was given the task of reorganizing the medical literature of America.

As an army surgeon Billings has been termed one of its foremost medical officers (Hume). During the Civil War he rendered distinguished service at Chancellorsville and at Gettysburg, where he operated for three days without rest. He was the first American surgeon to resect successfully the ankle joint (1862). His history of American surgery is the best in the English language.

After the Civil War, Surgeon General Hammond gave Billings the assignment of directing the Library of the Surgeon General's Office. Billings had the foresight to recognize the need of a large library for the advancement of American surgery and medicine. Since his day this library, now known as the Army Medical Library, has become the largest in the world. Although this is not a true contribution to abdominal surgery, as many others already mentioned, nevertheless, the realm of books is an essential part of the surgeon's armamentarium. For to paraphrase Osler, the surgeon who does not read books is like the captain who goes to sea without a knowledge of navigation.

Billings realized that a mass of books with no catalogue would be like an auto without a steering apparatus. Thus he devised the *Index Catalogue*, the largest compendium of bibliography ever developed (1880). He also founded the *Index Medicus*, now called the *Quarterly Cumulative Index Medicus*, which supplements the great catalogue.[11]

As a bibliographer, Billings achieved world fame and honorary degrees from European universities. At the time of his death he was the best known American surgeon to European scientists.[17]

THE AMERICAN SURGICAL DISEASE

A surgical disease which is truly American from the point of view of frequency of occurrence in Americans, and the elucidation of its pathology and cure, is appendicitis. Before the American surgeons solved the riddle of appendicitis, the abdomen was forbidden territory, and the operative treatment awaited its destined birth.

American surgery again enrolled itself upon the honor roll of everlasting fame by the exposition of the vermiform appendix. The first step in the recognition of appendicitis was taken by George Lewis, of New York, (1856). Then followed the operation of Willard Parker (1800–1884) for perityphlitic abscess, which was simply an evacuation of the abscess (1867). Subsequently the removal of the appendix was accomplished by R. J. Hall, of New York, and Thomas G. Morton, of Philadelphia.

For the complete understanding of this lesion, all honor goes to Reginald Heber Fitz (1843–1913), of Boston. The indications for surgical treatment were definitely expounded in 1889 by Charles McBurney (1845–1913), of New York.

The story of appendicitis unfolds during the last half century. "First the disease had to be recognized and that takes us back to the Massachusetts General Hospital. Here young Fitz, recently returned from study under Virchow, was made Keeper of the Pathological Cabinet at the hospital. For some reason he became interested in what was commonly called typhlitis and perityphlitis. Soon he convinced himself that the appendix was the cause of this condition and that it was an unnecessary organ of the human body. Finally, when the Association of American Physicians was to hold its first meeting in June, 1886, he was scheduled to read his paper. This was entitled, "Perforating Inflammation of the Vermiform Appendix; with Special Reference to its Early Diagnosis and Treatment."[9,10]

At this meeting Fitz showed by comparison of many cases that perityphlitis and perforating appendicitis were the same pathological condition. In addition he outlined the main symptoms and used the name appendicitis for the first time.

While Fitz was telling the surgeons what they ought to do, European surgeons continued to treat the disease conservatively.

In America his advice was accepted, and the world began to hear of McBurney, Murphy, Senn, Sands, Fowler and Ochsner.

As previously mentioned Dr. Hall successfully removed an inflamed appendix. However, this operation was undertaken for what was thought to be an incarcerated inguinal hernia. When the hernial sac was opened, peritonitis due to a gangrenous appendix was found. In 1887, Thomas George Morton (1835–1903) diagnosed appendicular disease, operated, opened an abscess and removed the appendix with a successful result. This was the first successful appendectomy in which the operation was primarily undertaken for a diseased appendix.[7]

However, the great advancement in the early diagnosis and operative interference in appendicitis was due to the efforts of Sands and McBurney. Henry B. Sands (1830–1888) was the assistant of Willard Parker from 1867 to 1870; from him he learned how to open a perityphlitic abscess. Sands is entitled to remembrance because he taught surgeons how to recognize the early signs of perforated appendicitis and advocated early operation.[7]

To the work of Sands was added the efforts of Charles McBurney (1845–1913). His paper published in 1889 established by clinical experience the utter necessity for early operation in appendicitis.[7] He insisted that there was a specific area especially tender in cases of appendicitis. What is now known as McBurney's point was described thus: ". . . the seat of greatest pain determined by the pressure of one finger, has been very exactly between an inch and a half and two inches from the anterior spinous process of the ilium on a straight line drawn from that process to the umbilicus."[20] From that day (November 13, 1889) the early operation for appendicitis as taught by such surgeons as Murphy and Senn became customary in America.

Other important therapeutic measures were instituted by Americans. Alonzo Clark (1807–1877), of New York, introduced the use of opium in peritonitis (1885). Another New Yorker, George Ryerson Fowler (1848–1906), advocated the sitting up position for cases of peritonitis. Thus inflammatory exudates would flow into the pelvis where absorption is not as rapid and drainage could be accomplished more satisfactorily.[7]

A new era was born in the field of abdominal surgery. Operations for the cure of appendicitis are performed daily. To this new surgery, American ingenuity was the major asset. Our nation achieved a brilliant triumph in this phase of abdominal surgery. To American surgeons perennial tribute must be given for initiating appendectomy and for perfecting its technic.

PATHFINDERS IN BILIARY AND GASTROINTESTINAL SURGERY

Less notable than the story of appendicitis but equally as important is the history of American surgery of the biliary and gastrointestinal tracts. Early surgery of these vital structures began with the repair of intestinal wounds. Later resection of the intestine, followed by anastomosis was perfected.

Intestinal wounds stimulated the interest of American surgeons as early as 1805. This subject was the inaugural treatise of Dr. Thomas Smith at the University of Pennsylvania. Samuel Gross, in 1843, experimented on dogs as to the nature and treatment of these wounds. Later he applied these results to actual practice. J. Marion Sims corroborated the method of Gross. This involved the excision of a section of the intestine with suturing of the divided ends. Gross never performed this procedure. It was in 1863 that Dr. Kinloch, of South Carolina, accomplished this result. However, it remained for Dr. N. T. Bull to make the practice safe. The efforts of Nicholas Senn and Abbe in intestinal anastomosis deserves distinction.

Other efforts were made in gastrointestinal surgery, however, most of these are

scattered reports. For example, in 1834, Luzenberg opened a strangulated hernia and excised the gangrenous bowel. The patient recovered.[22] *The Boston Journal of Medicine* of June 23, 1845, contains an article by a Dr. Manlore. This account reports a laparotomy for obstruction. An involuntary ileostomy was performed because the bowel was adherent to the abdominal wall. The author advocated this procedure in all cases of volvulus and intussusception.[5]

This same journal of July 23, 1868, contains a report by Dr. R. Wilder on "strangulation of the large intestine by a band." In this case he opened the abdomen, released the band with immediate relief. Five years later, Cheever reported a similar case with complete recovery of the patient.[5]

On September 23, 1885, an unfortunate man swallowed a denture with four teeth. It lodged in the esophagus. When he entered the hospital three days later, it was behind the sternum. The patient could not eat and lost much weight. A young surgeon, Maurice Richardson, opened the abdomen and stomach. He reached through the cardia up into the esophagus. With difficulty he liberated and delivered the denture. This procedure was the first of its kind to be reported.[5]

During these years sporadic successes with laparotomy, for various causes, found their way into the literature. The first and only successful laparotomy for the relief of perforation of the intestine due to typhoid fever is attributed to Dr. W. Van Hook, of Chicago. Laparotomy for the relief of purulent peritonitis was performed by Mears, of Philadelphia. This procedure was among the first in which the peritoneal cavity was opened for the purpose of draining the cavity. In association with this topic other names are prominent. Commendation must be given to Hartley, Curtis, Stimson, Morton and Vanderveer.[8]

The question of suture material fascinated American surgeons. Henry O. Marcy, of Otis, Massachusetts, introduced antiseptic ligatures in the radical cure of hernia, using kangaroo tendon (1878). Fourteen years later, Robert Abbe (1851–?) introduced catgut rings in intestinal surgery. One of the most ingenious and useful suture in intestinal surgery is the Connell suture. This was devised by Gregory F. Connell (1875–) now of Oshkosh, Wisconsin.[7,8]

Surgery of the stomach was advanced at the hands of Americans. Christian Fenger unfolded new facts on cancer of the stomach. The first man to take a radiogram of the stomach and confirm his findings surgically was John Conrad Hemmeter (1896). In addition he was a pioneer in duodenal intubation.[8]

On May 5, 1898, Dr. Charles B. Brigham reported a successful gastrectomy in the *Boston Medical Journal*.[5] He removed the entire stomach for cancer. An anastomosis was then made between the esophagus and the duodenum by means of a Murphy button. Two other names are prominently attached to the technic of gastrectomy both for cancer and ulcer. These men, both New Yorkers, are Albert Ashton Berg (1872–) and the late beloved George David Stewart (1862–1933).

Preoperative care of the gastrointestinal tract was emphasized for the first time by an American (1900). It was through Harvey Cushing that surgeons realized the possibility of rendering the stomach and intestines sterile as a preparatory measure to operations.[21]

Abdominal surgery of infancy and childhood has been promoted by American surgeons. Among these men are: C. L. Scudder, E. J. Donovan, William Ladd and Robert Gross. Through these surgeons and others pediatric surgery has become a specialty within the specialty of abdominal surgery.

One of the aspects to the explanation for the enviable surgical position America has reached is her contribution to gastrointestinal surgery. In this phase of abdominal surgery, America displayed the inherent characteristic of a young nation; first, to

equal, then to excel the accomplishments of older nations.

This characteristic was further demonstrated in biliary surgery. In colonial days, John C. Warren excised biliary calculi by incision into the umbilical vein.[5,23] At the University of Indiana, Dr. John S. Bobbs was dean of medicine. He is the founder of cholecystotomy. On June 16, 1867, he opened a patient's gallbladder and extracted fifty calculi.[26] The next year witnessed a similar performance by J. Marion Sims. In 1879, Robert Lawson Tait (1845–1899), of Alabama, perfected cholecystotomy.[11]

Dr. Fenger became interested in diseases of the biliary system. This was due to Phineas Conner, of Cincinnati, who incised adherent suppurating gallbladders and removed gallstones. Thus it was that Fenger explained the ball-valve action of biliary calculi and their relationship to the production of jaundice.

The last decades of the nineteenth century produced additional data on the biliary system. W. B. Davis, of Alabama, did excellent work on the anatomy and surgery of the biliary ducts (1890). More difficult surgery was now attempted by American surgeons. On March 23, 1893, G. W. Jones reported making an anastomosis between the gallbladder and intestine for stricture of the common duct.[5] Five years later Halsted excised the ampulla of Vater and the papilla of the common duct because of cancer. A successful implantation of the common duct into the duodenum for the relief of stricture was reported, in 1908, by Horace W. Packard.[6]

Bile duct surgery continues to receive the greatest attention from American surgeons. Such interest has given birth to the use of vitallium tubes in biliary surgery. The pioneer in vitallium surgery of these structures is Herman E. Pearse, of Rochester, New York. Other surgeons to follow his leadership were: Howard M. Clute, of Boston, Ben Seaman, Russell Fowler and John Raycroft all of New York.

The remarkable work in biliary surgery typifies the courage of American surgeons. Their ability to undertake a new project with the utmost vigor and enthusiasm is here manifested. Self-reliance such as this has developed the art of surgery in America and has obtained for our nation the admiration of the civilized world.

THE PEERLESS SURGEONS

"Progress always rests upon a small number of men of genius. Thus we have in the science of surgery in every epoch and every country, a certain number of renowned men who are the causes and pillars of this achievement." (Wm. J. Mayo.) Progress in American surgery was accelerated by several men of genius. Although many generations are represented, only the most famous characters will be recalled to mind in this surgical saga of our own native land.

Among the pioneer surgeons of the Middle West was Nicholas Senn (1844–1909). Born in Switzerland, he came to America (1852) and settled in Chicago. As an early exponent of scientific and experimental surgery, he concerned himself with abdominal surgery. He devised a method of detecting intestinal perforation with hydrogen gas (1888). The merits of Senn were in stressing surgical technic and in experimental abdominal surgery. He was among the first experimenters in gastroenterostomy and bowel anastomosis. For intestinal anastomosis he used decalcified bone plates. Senn was the founder of the Association of Military Surgeons of the United States (1891). From 1905 to 1908 he was editor of *Surgery, Gynecology & Obstetrics*. At one time he was professor of surgery at Rush Medical School.

The work of Senn led naturally to the accomplishments of John Benjamin Murphy (1857–1916). One of America's own world acclaimed surgeons, Murphy is remembered especially for the "button" which bears his name. The Murphy button is a great aid in intestinal anastomosis. His fame in America is associated with the

founding of the American College of Surgeons.[18]

A more recent leader of Midwest surgery was Albert J. Ochsner (1858–1925). For five years he was Senn's chief-of-staff, and began in this clinic his distinguished work known as Ochsnerization. This is the treatment of appendicitis when operation is not advisable or available.

At the turn of the century two master surgeons enjoyed positions of eminence. These men were Deaver, of Philadelphia, and Halsted, of Baltimore. John Blair Deaver (1855–1931) was one of the most skillful operators of this period. He was an exponent of what he called "living pathology." The egregious character of his work is illustrated in his writings on: *Appendicitis* (1896), *Prostatic Hypertrophy* (1905), *The Breast* (1917), and a *Surgical Anatomy* (1901), in three volumes.[4]

An expert in the art of healing was William Stewart Halsted (1852–1922). As first professor of surgery at Johns Hopkins, he was a quiet but effective force in molding American surgery into a composite science. In addition to his introduction of sterile rubber gloves, he was a pioneer in the use of silk ligatures and cocaine infiltration anesthesia. He devised numerous operative procedures, such as those for radical mastectomy (1889) and herniorrhaphy. If any one man is to be given credit for initiating specialism in surgery, it is Halsted. He trained men who eventually became masters in different branches of surgery. During an all star operation, Halsted would operate with Cushing, Finney, Bloodgood, Young and Baetjer as assistants. Each of these assistants achieved deserving fame, some of whom pioneered in other branches of surgery. To these surgeons he taught the delicate art of the perfect healing of wounds, which was masterly demonstrated at his clinics.[11]

Halsted showed the necessity for the gentle handling of tissues as a corollary to the prevention of wound infections for the protection of patients against surgical shock. To him all honor is due for the abolition of the rough and ready surgery which was prevalent before his day. Americans are justly proud of Halsted; he not only developed the science of surgery but cultivated its art as well.

The late George Washington Crile (1864–1942), of Cleveland, was known for many ingenious contributions to surgery. His experimental and clinical investigations of surgical shock and the reduction of operative shock by his procedure of "anoci-association" brought him to the attention of the medical profession. He achieved national fame for his technical ability of denervating the adrenal gland as well as for thyroidectomy.

All the world has heard of the Mayo Brothers. Their exceptional dexterity as surgeons, teachers and contributors to medicine made their names universally familiar. Founders of the world famous Mayo Clinic in Rochester, Minnesota, William James Mayo (1861–1939) and Charles Horace Mayo (1865–1939) were the authors of many accepted improvements in visceral surgery. By the establishment of their clinic they have opened the way for future discoveries in surgery. Many surgeons have been trained at the Mayo Clinic, and by their work have reflected honor and glory on the memory of Charles and William Mayo.[4] Among these master abdominal craftsmen mention is made of: E. Starr Judd (1878–1935), Donald C. Balfour, Waltman Walters and Fred Rankin. Today the Mayo Clinic is the post-graduate medical school of the University of Minnesota. At this university Owen H. Wangensteen is professor of surgery. He is noted for his remarkable work on intestinal obstructions. His book on that subject has been accepted as a classic and is destined to be one of the most valuable books in American medical literature.

The influence of the Mayo Clinic has been manifested in a different manner. Other clinics formed according to the Mayo pattern have been established in America. The most noted of these small

institutions is the Lahey Clinic, in Boston, founded by the distinguished surgeon, Frank Lahey. Here under the guidance of Lahey and Richard B. Cattell, young surgeons, through a system of fellowships, are trained in the flawless technic of graceful surgeons.

The accomplishments of these peerless surgeons must be evaluated according to the standards of the period in which they lived. They were influential during a definite period of American surgical growth and development. There will never again be men of their caliber. This is not because similar personalities may not be born, but because the era in which they lived will never again be duplicated in America.[14]

CONCLUSIONS

Following the adoption of asepsis and anesthesia as definite supplements to surgical technic, America was contented to follow the established principles inherited from the old world. Later generations progressed beyond European influence to become pathfinders in abdominal surgery. America is now the seat of learning to which surgeons of the world may come for knowledge. This century finds the American surgeon the leading figure in the realm of surgical practice, progress and prestige.

This exalted position has been attained for many reasons. Among these are the generous allowances made by universities and private individuals for the study of experimental and clinical surgery. In addition, America has been liberal in remunerating deserving surgeons for their ability.[4] Another reason has been the impartiality with which American surgeons gleaned the harvest from European discoveries. America eagerly seized the surgical contributions of England, France and Germany. Thus America appropriated to her own use whatever principles, theories, discoveries, inventions or knowledge Europe had to offer. With this adaptability for assimilating proffered knowledge, American surgeons, adding their own observations, contributed generously to the resources of surgery.[13]

Not only have American surgeons aimed to reach the acme of perfection, but they have examined themselves in order to maintain that supremacy. "This is reflected in the facilities for long term specialized education of the young surgeon. The high standards set for certification by the American Board of Surgery have been a very stimulating influence in maintaining the high level of surgical practice. The influence of the American College of Surgeons has assisted in improving surgical practice throughout the nation due to the increased standards for admission to fellowship."[13]

With the advent of a proper pathological basis for understanding disease, the American surgeon quickly accepted the need for training in pathology. This was a radical departure since hitherto surgeons relied primarily on anatomy as a basis for surgical proficiency. In the present century American surgeons have advanced further. They have added normal and pathological physiology to their knowledge as a requisite for surgical excellency.[4]

America has set high qualifications for the perfect surgeon: "He must be a physician possessed of the high ideals of a Hippocrates, the anatomical knowledge of a Vesalius, the alertness and fearlessness of a Paré, the intuitions and curiosity of a Hunter, the imagination of a Pasteur, and the industry and honesty of a Lister. To these must be added the good judgement which marks the difference between technical efficiency and true ability."[12] The essential ingredients, however, in the make-up of the surgeon are the mental, the moral and the mechanical. "The first has to do with knowledge, the second with judgement, and the third with skill. In such order they provide the why, the whether, and the how of every surgical question. The American surgeon recognizes this trinity of attributes and happy indeed is he—and rare in the extreme—who may possess them all in equal degree."[24]

These troubled days of war, commercialism, and social complexes welcome the ideals and aspirations of the medical scientist. "The commercial world exalts those who accumulate wealth; the politician defies the narrow-minded nationalist; and the unthinking citizen finds his hero in the theater. Surgery engrossed in scientific investigation and its application to the relief of human suffering, reserves its insignia of greatness for those who find their satisfaction in service and in the search for the elusive secrets which benefit mankind. The American surgeon, in common with all scientists, loves to wrest from nature its secrets for the pure joy of increasing knowledge. He may be oblivious of its immediate application, but he is confident of its ultimate value in alleviating human suffering."[16]

The turbulent era through which we are passing threatens to stifle surgical progress. "All other continents have forgotten the advancement of surgical science because of the war. The post-war years will be more occupied with reconstruction, than surgical prestige. Therefore, the preservation of present surgical standards and the energy for progress must arise from America."[13] Thus when a future historian of surgical history evaluates America, he can write that American surgeons have not only been illustrious pioneers in their specialty, but have also preserved, protected, and advanced it during the most critical period of its existence.

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Selected Book Reviews

AFTER all has been said and done one looks to the book review pages hoping to get some idea if certain books are worth owning, or if they contain the information one seeks. The reader wants to know if a book under discussion is "just a book," a run of the mill affair, or a book that has been written "from the ground up," whether it is a book of merit, a book that one can refer to with confidence, knowing it is scientifically sound.

In the past year medical book publishers have done very well. It has been rumored they have been having a field day. If sales have been brisk, it is because the publishers have given, for the most part, quality. The many recent new books and new editions have been good books, books that have and will fill many and various needs.

We cannot go into detail about many of these works because of space limitations due to paper shortage. As has been said before, we print only two columns (sometimes but one) and paper does not stretch. Therefore, we will recite bare facts and omit the details concerning a few volumes on our desk.

For the surgeon and the general practitioner (for it is the general practitioner who sees the patient first) we highly recommend "Diseases of the Breast" by Charles F. Geschickter,[1] with a special section on treatment written in collaboration with Dr. Murray M. Copeland. The authors are men of experience. This work of 829 pages and 593 illustrations plus an ample index covers diagnosis, pathology and treatment of breast conditions. References are at the chapter endings. The work is divided into seven parts and is well written; the illustrations are exceptionally fine. Would that all physicians who see patients with breast conditions were familiar with this volume.

"The Principles and Practice of Obstetrics" (8th Edition) by Joseph DeLee (what physician does not know this book?) has now

[1] Diseases of the Breast. By Charles F. Geschickter. Philadelphia, 1943. J. B. Lippincott. Price $10.00.

been brought out in a new edition by Dr. J. P. Greenhill.[2] Dr. Greenhill has rearranged the material in the first third of the book; he has substituted English terms for Latin ones in the designation of presentation and position, and has added new chapters or sections dealing with obstetric and gynecologic endocrinology. The use of vitamin K in obstetrics, erythroblastosis fetalis, vitamins and minerals, roentgenography in obstetrics, the sulfonamide drugs in obstetrics, and the Waters extraperitoneal cesarean section are thoroughly done. Several chapters have been rewritten. Dr. Greenhill has done an excellent job and has made a book, that was a standard for several decades, a much better book.

The Williams & Wilkins Company, of Baltimore, have published, under the title "Pain," the Proceedings of the Association for Research in Nervous and Mental Disease.[3] This association has brought out research publications annually since 1920. "Pain" is a book of 468 pages with 116 illustrations and nineteen tables. The editorial board responsible for the finished work comprised Harold G. Wolf, Chairman, Herbert S. Gasser and Joseph C. Hinsey, and about thirty-seven scientists contributed to this volume. A bibliography is at the conclusion of each chapter and there is a good index. Those interested in this title will find the reading of this work profitable and stimulating.

"The Modern Management of Colitis" by J. Arnold Bargen,[4] Chief of the Section on Intestinal Diseases, Mayo Clinic, is not only timely but is a book that could well be studied by a majority of physicians. It deals with nature and causative factors of colitis, characteristic lesions, symptoms and clues to inception; we are given precise diagnostic criteria and treatment and the purpose of the various modes of treatment. There are case reports and consideration of complications and sequelae. This monograph of 322 pages and 148 illustrations, with references and index for the reader's convenience, is an outstanding and worth while work.

We have before us the fourth Edition of Max Thorek's "Surgical

[2] Principles and Practice of Obstetrics. 8th ed. By Joseph B. DeLee and J. P. Greenhill. Philadelphia, 1943. W. B. Saunders. Price $10.00.

[3] Pain. Proceedings of the Association for Research in Nervous and Mental Disease. Vol. XXIII. Baltimore, 1943. Williams & Wilkins. Price $7.50.

[4] The Modern Management of Colitis. By J. Arnold Bargen. Springfield, Ill., 1943. Charles C. Thomas. Price $7.00.

Errors and Safeguards."[5] There is a foreword by Sir Hugh Devine and a chapter on Legal Responsibility in Surgical practice by Dr. Hubert Winston Smith. The book was first published in 1932. When a book of this size and scope (1085 pages and 795 illustrations, many of them colored) comes out in a fourth edition in ten years, that book must be a good and necessary tome. Naturally, it is well and clearly written. The illustrations are of a high order and the volume abounds in references and is amply indexed. That Thorek's work is now offered in a fourth edition is enough recommendation.

By the way, have you read Dr. Thorek's autobiography,[6] "A Surgeon's World"? We picked it up thinking it would prove to be just another prominent medico resorting to the pen in order to tickle his ego and vanity, and instead found ourselves fascinated. Pick it up a half hour or so before bedtime and become acquainted with the boy at school in Budapest, the student who played snare drums to get his medical degree, the physician who mended Mother Mellaney's sons, the surgeon who planned and built a hospital. This autobiography makes for lively reading, for not only do you become acquainted with the author but you will meet homey little sketches of others' lives.

We have just enough space left to refer briefly to three books, mainly of interest to gynecologists, but others might well enjoy them, too.

The first one is called "The Genealogy of Gynaecology." It is by James V. Ricci[7] and is a history of the development of gynecology throughout the ages—2000 B.C. to 1800 A.D. There are excerpts from many authors who have contributed to the various phases of the subject. It is a storehouse of facts, dates, names and places dealing with the development of the theories and therapies of female diseases throughout the ages. Here and there through the text are many phrases of elegance and beauty chosen from the masters in the art of expression which add charm and meaning to the gynecological items culled from the past. The material while always instructive is often amusing. This work of 578 pages with fifty-four illustrations

[5] Surgical Errors and Safeguards. 4th ed. By Max Thorek. Philadelphia, 1943. J. B. Lippincott. Price $15.00.

[6] A Surgeon's World. By Max Thorek. Philadelphia, 1943. J. B. Lippincott. Price $3.75.

[7] The Genealogy of Gynaecology. By James V. Ricci. Philadelphia, 1943. Blakiston Company. Price $8.50.

has an index of personal names and an index of subjects. It is good reading.

Willard R. Cooke,[8] author of "Essentials of Gynecology," says in the preface, "The object of this book is to present concisely, from the practical viewpoint, and with as much correlation as possible, the salient features of the anatomy, pathology, symptomatology, and therapy of gynecology. In practice both diagnosis and treatment should be based as far as possible upon a knowledge of the norms and of the various anatomic and physiologic pathologic states; hence, in the arrangement of the subject material, an effort has been made to place the descriptions of the pathologic states immediately before the clinical discussions in order to facilitate such correlation." The author lives up to his blueprint and writes from his teaching and clinical experience. This book (474 pages) has 197 illustrations, ten of which are in color. Dr. Cooke, professor of obstetrics and gynecology at the University of Texas School of Medicine since 1925, is considered one of the best known men in his field in this country and has written a book worthy of his reputation.

"Gynecology with a Section on Female Urology," by Lawrence R. Wharton,[9] is another solid work on this subject. The author has succeeded in putting into simple and clear form the main facts about gynecology. He has distinguished between fact and fiction and has stressed established principles, and, in discussing unsettled problems has considered representative opinions, however divergent they may be. A good deal of space has been devoted to female urology. Whether one practices urology or not he must, if he is a gynecologist or an obstetrician, be familiar with the normal function and pathological changes in the female urinary system, the results of accidents, and in more than a general way know how to meet and handle these situations. We hope all textbooks in the future will give ample consideration to urological problems in connection with gynecology and obstetrics (a consideration of the lower bowel, anus and rectum might be dealt with, too, with profit).

This is a textbook. It is well designed for medical students. Teachers of this subject would do well to list this work as the main textbook to use or as a work for supplementary reading.

[8] Essentials of Gynecology. By Willard R. Cooke. Philadelphia, 1943. J. B. Lippincott. Price $6.50.

[9] Gynecology with a Section on Female Urology. By Lawrence R. Wharton. Philadelphia, 1943. W. B. Saunders. Price $10.00.

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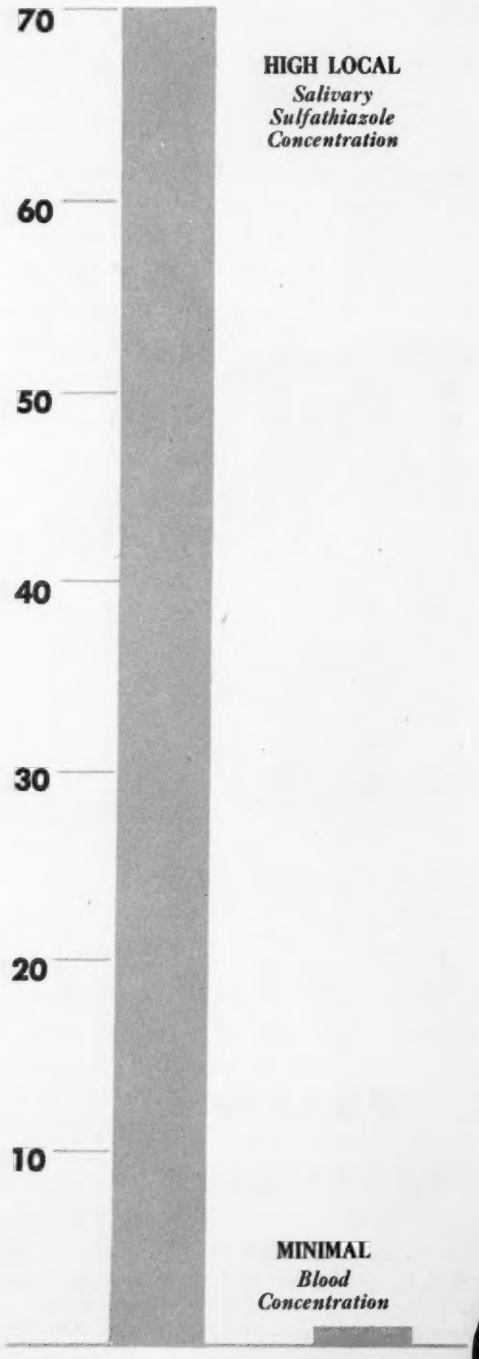

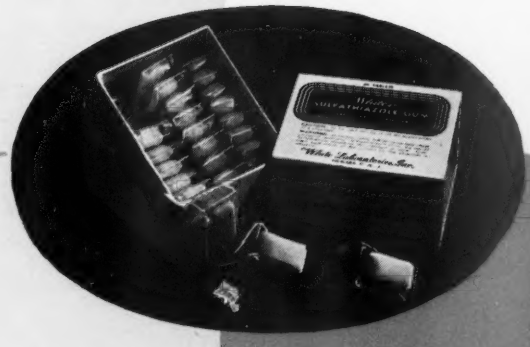

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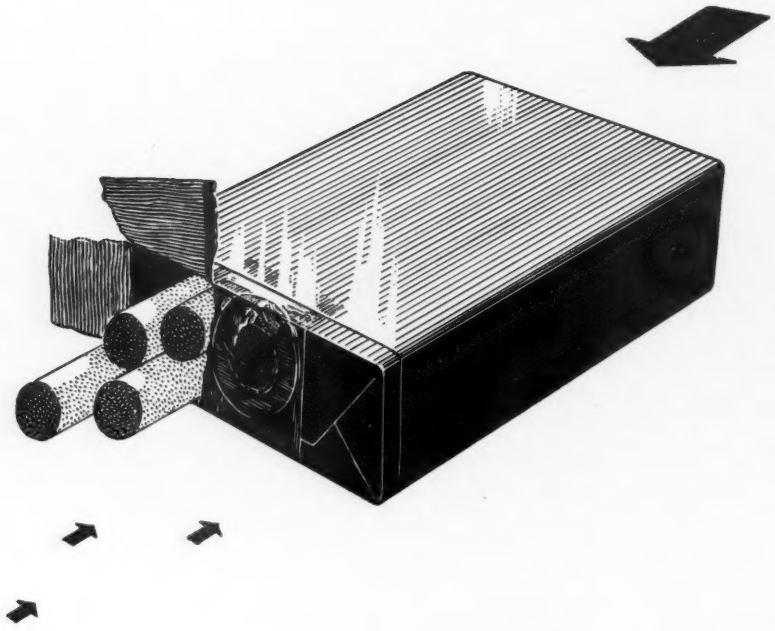

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*Meyer, E., and Arnold, L. (1938) Amer. J. Digest. Dis., 5:418

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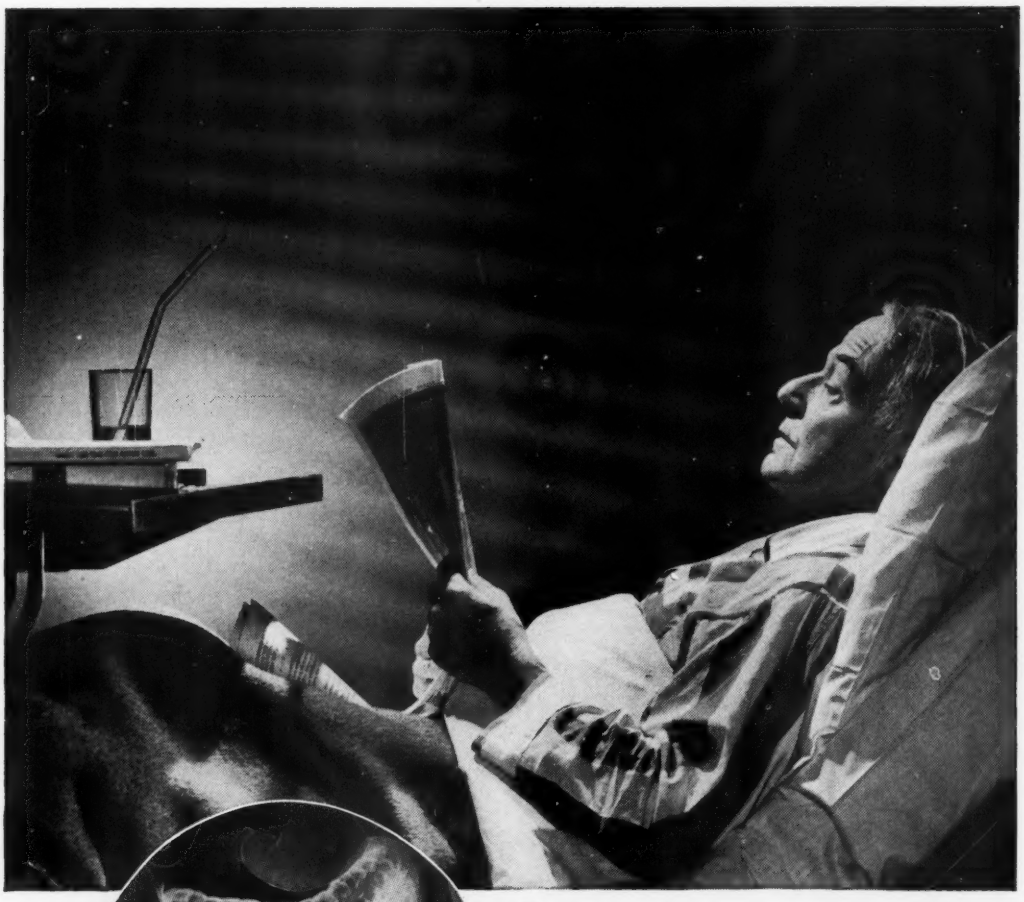

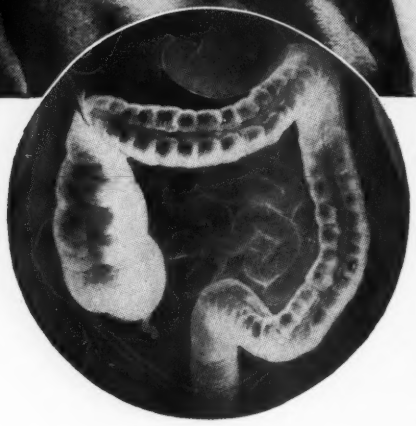

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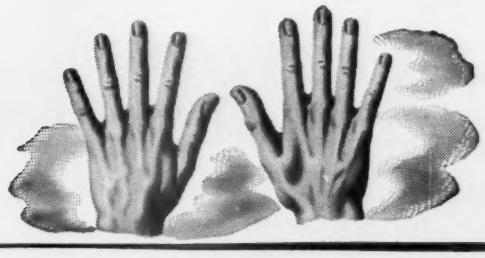

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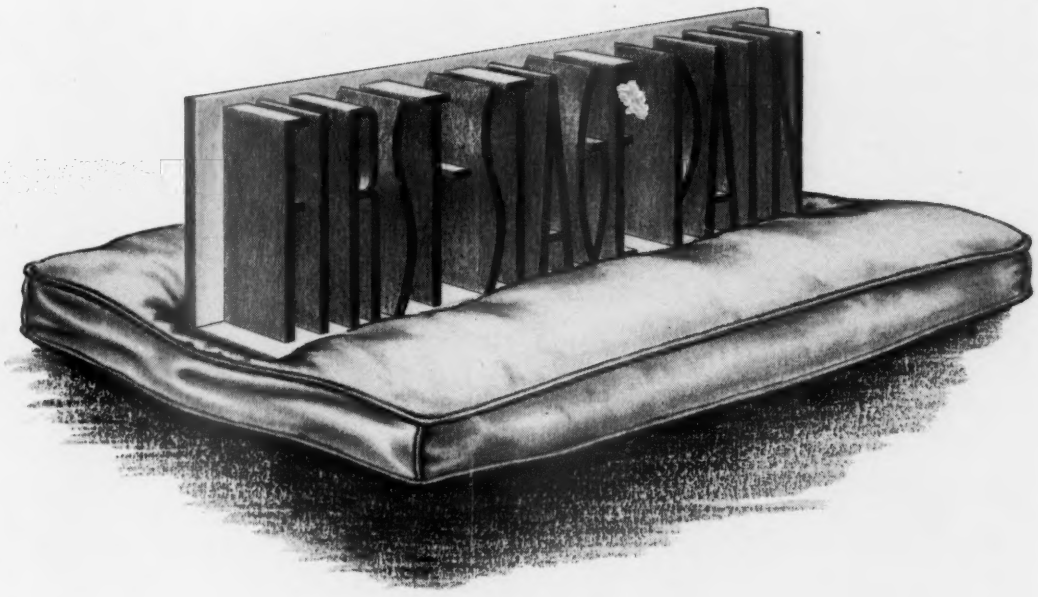

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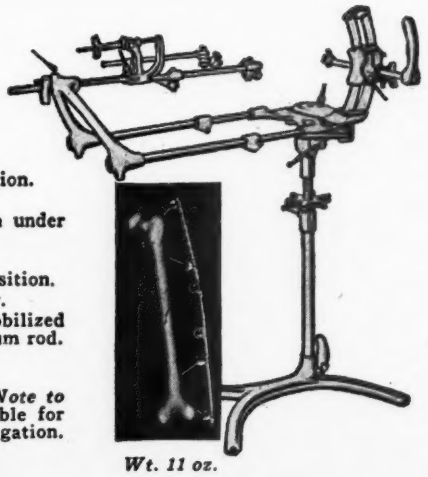

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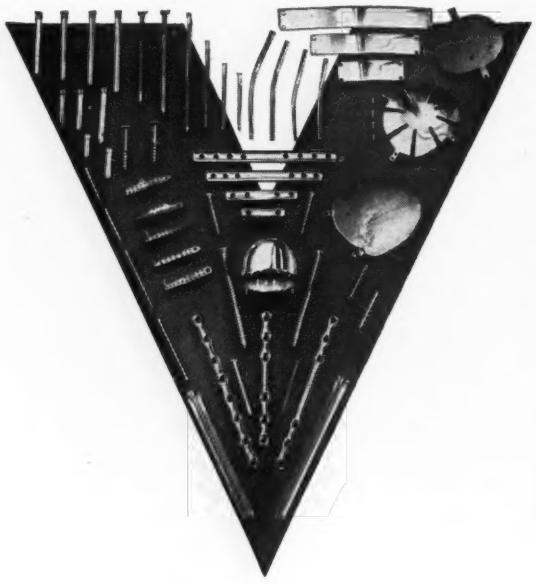

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The speed of the reparative processes after surgery or severe trauma depends largely upon the resources of the organism and upon the "repair materials" made available in the dietary. While caloric intake is of comparatively little moment, the usually increased metabolic rate, together with the demands of tissue regeneration, sharply advances the requirement for the "Big Three" of the postsurgical diet—proteins, B vitamins, minerals.

Cereal breakfast foods, such as corn flakes, corn cereals, farina, oat cereals, oatmeal, puffed cereals, rice cereals, wheat cereals, and wheat flakes, merit early inclusion in the postoperative diet. They are not only completely bland but also almost totally digestible.

Nutritionally, cereals make a noteworthy contribution to the diet. Their protein (average content 10%) is highly acceptable to the organism, applicable to growth as well as to maintenance. Their contents of B vitamins and minerals, especially iron of good availability, are appreciable.

When 1 oz. of such cereals (whole-grain, enriched, or restored to whole-grain values of thiamine, niacin, and iron) is served with 4 oz. of whole milk and 1 teaspoonful of sugar, this palatable dish presents the following (composite average) values:

Calories	**205**	
Protein	**7.0**	**Gm.**
Carbohydrate	**33.0**	**Gm.**
Fat	**5.0**	**Gm.**
Thiamine	**0.18**	**mg.**
Riboflavin	**0.30**	**mg.**
Niacin	**0.84**	**mg.**
Calcium	**0.16**	**Gm.**
Iron	**1.29**	**mg.**

Cereals present an additional advantage in their wide variety of taste and form. Rare indeed is the patient who will not accept some cereal or other at least once or twice per day. In many instances cereals prove an excellent means to make milk acceptable to a patient who otherwise cannot be induced to consume it as such.

The presence of this seal indicates that all nutritional statements in this advertisement have been found acceptable by the Council on Foods and Nutrition of the American Medical Association.

CEREAL INSTITUTE INC.

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A cooperative effort to present the nutritional value of cereal breakfast foods (whole-grain, enriched, or restored to whole-grain values of thiamine, niacin, and iron), undertaken jointly by THE CREAM OF WHEAT CORP. . . . GENERAL FOODS CORP. . . . GENERAL MILLS, INC. . . . KELLOGG COMPANY . . . NATIONAL BISCUIT COMPANY . . . PILLSBURY FLOUR MILLS COMPANY . . . THE QUAKER OATS COMPANY . . . CAMPBELL CEREAL CO. . . . ALBERS MILLING CO.

Future fertility is not impaired

● The essence of planned parenthood is that temporary contraceptive measures will not interfere in any way with future fertility.

The jelly and cream methods generally are considered by authorities to have no influence upon fertility subsequent to discontinuance of use and there are among our own experimental clinic series sufficient instances of successful planned pregnancy following Ortho-Gynol Vaginal Jelly contraception to substantiate this belief.

The conscientious physician may be assured that future fertility is not impaired by the use of Ortho-Gynol Vaginal Jelly.

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ortho-gynol
VAGINAL JELLY

ACTIVE INGREDIENTS: *Ricinoleic Acid, Boric Acid, Oxyquinoline Sulfate.*

The American Journal of Surgery

ADVERTISERS INDEX

Instruments and Apparatus

A. S. Aloe Company ..... *January*
Austenal Laboratories, Inc 38
Bard-Parker Company, Inc ..... *January*
Becton, Dickinson & Co 20
Crescent Surgical Sales Co., Inc ..... *January*
General Electric X-ray Corp 12
Fred Haslam & Co., Inc 36
Kny-Scheerer Corp ..... *January*
Geo. P. Pilling & Son Co 14
Singer Sewing Machine Company 18
J. Sklar Manufacturing Co 19
The Tower Co., Inc 34
United States Catheter & Instrument Corp ..... *January*
Edward Weck & Co., Inc 9
Zimmer Manufacturing Co ..... *January*

Sutures

Bauer & Black 7
Davis & Geck, Inc ..... *Insert Facing 2nd Cover*
Gudebrod Bros. Silk Co., Inc 13

Pharmaceuticals

Abbott Laboratories 28
American Hospital Supply Corp 25
Ernst Bischoff Co., Inc 34
Cheplin Biological Laboratories, Inc 8
Ciba Pharmaceutical Products, Inc ..... *Back Cover*
Cutter Laboratories 11
E. Fougera & Co., Inc 39
Hoffmann-La Roche, Inc 5
Johnson & Johnson 24
The Lavoris Company ..... *January*
Lederle Laboratories, Inc ..... *January*
Thos. Leeming & Co., Inc 1
Eli Lilly and Company ..... *January*
The S. E. Massengill Company 37
Merck & Co., Inc ..... *January*
The Wm. S. Merrell Company 16–17
McNeil Laboratories, Inc 33
National Drug Co 31
Ortho Products, Inc 10, 42
Parke, Davis & Co ..... *January*
Rare Chemicals, Inc ..... *January*
Schuylkill Chemical Co 36
E. R. Squibb & Sons 22
Frederick Stearns & Company 21
Wallace & Tiernan Products, Inc 29
White Laboratories, Inc 23, 26–27
Winthrop Chemical Co., Inc 2, 35
John Wyeth & Brother, Inc 30

Hospital Supplies

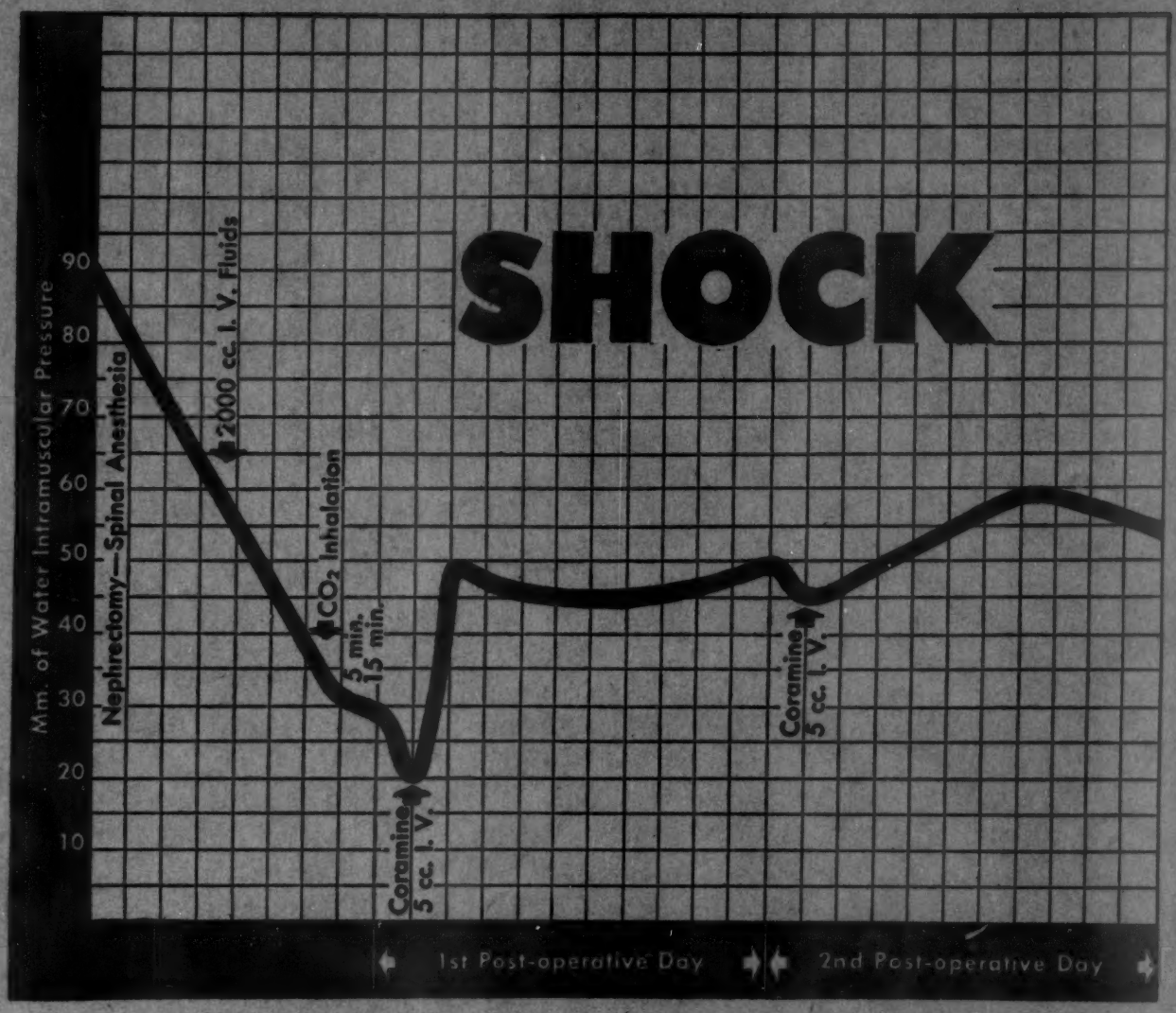
A. S. Aloe Company ..... *January*
American Hospital Supply Corp 25
Bard-Parker Company, Inc ..... *January*
Becton, Dickinson & Co 20
Clay-Adams Co., Inc ..... *January*
Crescent Surgical Sales Co., Inc ..... *January*
Cutter Laboratories 11
General Electric X-ray Corp 12
Fred Haslam & Co., Inc 36
Harris Laboratories ..... *January*
Kny-Scheerer Corp ..... *January*
Macalaster Bicknell Company 6
Mallinckrodt Chemical Works 15
J. Sklar Manufacturing Co 19
The Tower Co., Inc 34
Edward Weck & Co., Inc 9

Post-Graduate Instruction

Cook County Grad. Sch. of Med 32
N. Y. Polyclinic Med. School 32

Foods

Cereal Institute Inc 41
The Wander Company ..... *January*



SHOCK is a complex syndrome having many causes and presenting many symptoms. Recent research[1] has demonstrated that in post-operative and post-anesthetic shock *intramuscular pressure drops before venous pressure fails.* This intramuscular pressure is of greatest importance in maintaining peripheral circulation and venous pressure is returned to normal by a restoration of intramuscular pressure.

CORAMINE,* of all the drugs tested, was found to promptly and spectacularly increase intramuscular pressure to normal. It was used intravenously in doses of 5-10 cc.

[1]Gunther, Lewis, Engelberg, Hyman and Strauss, Ludwig., INTRAMUSCULAR PRESSURE, Am. J. Med. Sci., 204, 266-283, Aug., 1942.

CORAMINE

COMBATS SHOCK

AMPULS LIQUID

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SUMMIT, NEW JERSEY